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THE OCTOBER ISSUE

This is the second number of the INDUSTRIAL ARTS AND VOCATIONAL EDUCATION MAGAZINE since it has become a 10-issue-per-year periodical. The publisher hopes that the readers approve the change. In no way does the new plan mean a curtailment of what was previously offered. The present issue contains 3,919 square inches of printed matter on the various phases of industrial arts and vocational education. This is equivalent to a 6 by 9-in. book of 124 pages. Certainly not a mean contribution to the literature of our profession.

A glance through this or any other issue of the magazine shows its value to the shop instructor. The high professional standings of its contributors vouch for the worth of the material published. In this particular issue, for instance, appear the following articles which no shop teacher who wishes to advance professionally can afford to overlook: "Chronological Development of the Industrial-Arts Concept," by L. F. Ashley; "A Philosophy of Industrial-Arts Education," by William L. Hunter; "100 Hobbies for the Junior-High-School Boy," by Burton T. Williams; "What Do Employers Expect Boys Entering the Trades to Know?" by Lillian Shuster, and "Girls and Their Education," by L. H. Harnsberger. Besides these, there are articles of special interest to the instructors of printing, auto mechanics, metalwork, art metalwork, mechanical drawing, woodwork, electricity, and ceramics.

Unfortunately, the monthly tracing supplement which had been a part of our magazine for so many years had to be discontinued upon advice of the postal department. This does not mean, however, that the shop teacher has to do without this valuable teaching aid. The editorial entitled "The Tracing Supplement" on page 322 will inform the reader just how we solved this problem.

Articles Indexed — The articles contained in the Magazine are regularly indexed in "The Reader's Guide to Periodical Literature," and "Education Index."
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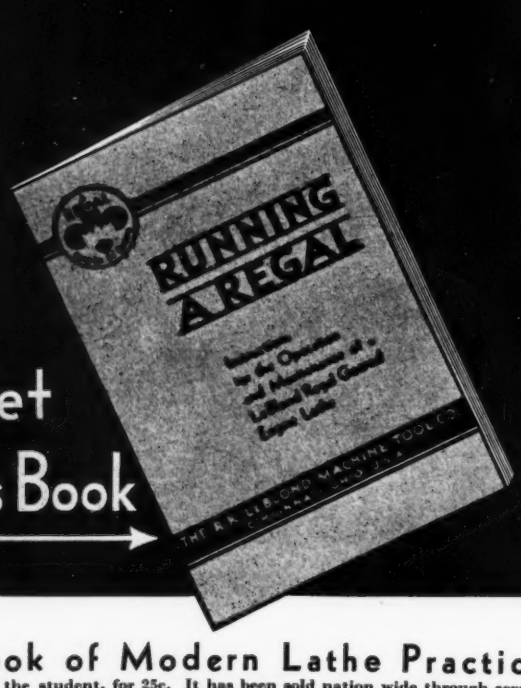

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CINCINNATI, OHIO, U. S. A.

October, 1937
Vol. 26, No. 10

INDUSTRIAL ARTS and VOCATIONAL EDUCATION

Chronological Development of the Industrial-Arts Concept

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That industrial arts as a school subject has come up through a maze of confused ideas of its place and worth is shown by the large number of terms by which it has been and continues to be designated. Warner (12, p. 5)[1] found as late as 1928 that the following twenty-eight expressions were used to designate the work of 358 shop teachers. The table also shows the frequency of mention.

1.	Manual Arts	113
2.	Manual Training	110
3.	Industrial Arts	74
4.	Vocational Teaching	45
5.	Industrial-Arts Education	37
6.	Shopwork	30
7.	Industrial Education	26
8.	Trade Work	17
9.	Practical Arts	13
10.	Technical Teacher	13
11.	Farm Shop	11
12.	Mechanic Arts	9
13.	Construction Work	8
14.	Industrial Work	6
15.	Arts and Crafts	6
16.	Handwork	5
17.	Woodworking	2
18.	Mechanical Drawing	2
19.	Manual-Arts Education	1
20.	"Pre"-vocational	1
21.	Vocational-Guidance Education	1
22.	Practical Manual Training	1
23.	Practical Training	1
24.	Craft Work	1
25.	Co-ordinator	1
26.	Mechanical Co-ordinator	1
27.	Industrial-Drawing Arts	1
28.	Industrial Sciences	1

The following additional terms have also been more or less before us as designating shopwork.

29. Apprenticeships
30. Guilds
31. Economic Schools
32. Handcraft
33. Polytechnics
34. Village School of Industry
35. Dynamic Experience
36. Manual Occupations in the Kindergarten
37. Kitchen Garden
38. Department of Science and Art
39. The Work School
40. Physiological Education
41. Vocational Industrial Education
42. Sloyd
43. Manual-Labor Movement
44. Vocational Education
45. Laboratory
46. Manual
47. Practical Manual Training
48. Kindergarten Work
49. Elementary Work

[1]The Arabic numerals found throughout this article refer to the references at the end.

These terms show the popularity of certain words as compared with others, but do not indicate a scientific determination of terms. It is evident that many of the words have been used loosely to denote the same thing, while some have had the same root derivation. An example is *hand* and *manual*. It may be seen that the following twelve terms head the list in frequency of use:

Manual arts, manual training, industrial arts, vocational teaching, industrial-arts education, shopwork, industrial education, trade work, practical arts, technical teacher, farm shop, and mechanic arts.

Due to the overlapping of meanings, simultaneous uses of some of them may be seen in the beginning. Most English terms go back to the dialects of the people and are not a matter of written record except as Chaucer gathered them together during the fourteenth century in his attempt to unify the language of the country. However, while the occurrence of certain words dates prior to the year A.D. 1000, there is little or no use of complete expressions before the sixteenth century. The concepts in present philosophy can scarcely be traced more than three hundred years, and the major developments are found in the last century.

The term, *manual arts*, like most of the other expressions, came gradually into use through the uniting of separate words composing the expression. The *Oxford Dictionary* shows the following uses of the word *manual:*

1406 Hoccleve — La Male Regle, 364. ". . . . and of thy *manuel* labor, as I ween . . ."

1581 Mulcaster (English School Master) ". . . . whose use of drawing, all modelling, all mathematics, all *manuaries* do find and confess to be so notorious and so needful."

1592 R. D. Hypeurtomachia 18b. "The chief inuention resteth in the architect, but the labor and working thereof to the vulgar and common sort of *manualists* and servants to the architect." *Manualist,* one who works with his hands, Obs.

1593 Fail-Dialing A III. ". . . . Beseeching the Lord who hath imbued you in all *manual* sciences."

1532–1533 Shakespeare, Act 24, Henry VIII, C. 4. ". . . . made and brought into this realme, redye wrought by manuall occupation."

The term, *training,* was also used by Mulcaster in 1581 (8, p. 236): "The general traine and bringing up of youth."

Cygnaeus, as head of the educational system, made *manual training* compulsory in all rural and town schools of Finland and coupled the terms *manual* and *training* to designate a school subject. By 1880, most of the country schools in Finland were known as "slojd" schools, and in 1882, there were some five hundred of them in Sweden. However, manual training in the United States is traceable more directly to a Russian influence. In 1868 M. Victor Della-Vos, Director of the Imperial Technical School at Moscow insisted that practical work should be given in school workshops not connected with the production shops if students in the Imperial Technical School were to make maximum progress. There were many small parts and models for machines which were considered well within the ability of teen-age boys which he thought could be made by them and thus they would acquire

A very helpful study, tracing the use of some of the words used to designate the shopwork in our schools.

basic skills needed in engineering shops. Dr. John Runkel, President of the Massachusetts Institute of Technology, had also come to this conclusion. Therefore, when the Imperial Technical Schools of Moscow and St. Petersburg exhibited samples of tools and other shopwork of Russian students at the Philadelphia Centennial in 1876, he visited the exhibition and at once became enthusiastic about the prospect of using similar models and tools as problems for experiences prerequisite to the engineering courses at the Massachusetts Institute of Technology. Several meetings were held and resolutions adopted for starting manual-training schools in Boston.

Among the champions of manual training in education in the United States at this time was Dr. Calvin Woodward, who founded a manual-training school as a department of Washington University in St. Louis. His book *Manual Training*, written in 1890, set forth in considerable detail the advantages of handwork in general education. Charles H. Ham produced a book entitled *Mind and Hand* in 1886; and Nicholas Murray Butler wrote *An Argument for Manual Training* about 1899. Ham had lectured considerably on the value of manual training as general education and thought of the work as growing out of the kindergarten movement, but now for all other age levels. He spoke of the shops as laboratories and advocated them for such subjects as carpentry, wood turning, wood patternmaking, foundry, forging, machine tool work, chipping, filing, and fitting. He thought of the work in these laboratories as educational and different from the production work in European schools as may be seen in the following (7, p. 368):

> Manual training in the public schools of Europe can scarcely be called educational since the pupils usually make articles for household use. The purpose is purely industrial, and hence the mental culture received in the course of the manual exercise is the mere incident of a mechanical pursuit. . . . The technical and mechanical art or trade schools of Europe, generally, whether public or private, do not come within the scope of this work since their purpose is industrial, not educational.

Several countries in Europe established schools for the preparation of manual-training teachers. France made such work compulsory in 1882, while Solomon in Sweden and Cygneaus in Finland had similar schools even earlier. The work spread in schools of the United States largely under the guise of general education. Woodward wrote much about the "fruits of manual training" and set forth quite a long list of educational values other than skills. However, the method used in the public schools quite defeated the purpose and the skills outcome dominated even though the trade outcome did not.

Handwork was welcomed as a splendid substitute for the purely classical subjects and manual-training high schools were established in all of the large cities beginning about 1883. Peru, Illinois and Baltimore, Maryland were contenders for the first place. Montclair, New Jersey, preceded them one year with manual training in the grades.

Designations Used

The term *manual training* was made more secure by its use in the literature which came from the press during the first quarter of the present century. The *Manual Training Magazine*, a predecessor of the *Industrial Education Magazine*, carried the term in its title until 1921, though its publishing house was called and is still known as the *Manual Arts* Press. However, many new terms began to appear in the publications pertaining to handwork in schools. The most popular of these was *manual arts*.

The *Oxford Dictionary* shows that *arts* was first used to designate *crafts*. Chronologically, the year 1225 was the earliest mention of it. Other uses follow:

> 1551–1776. The word was used with man as arts-man, to designate a craftsman or an artificer.
>
> 1589. Arts-master, came into use as a teacher of an art or a craft. Nash-Greene's Menaphon Ded. (Arb) 5. "Their idiot art-masters that intrude themselves. . . ." (*Oxford Dictionary.*)

Manual arts, according to Bennett (3), was used by Francis Bacon as early as 1605 to connote handcrafts. The next mention of the two words together (manual and arts) as given by the *Oxford Dictionary* was in 1725:

> Pope-Oddys. XV, 338. ". . . patron of industrial and *manual arts*."

Hutchinson (13, p. 3) found that the term was brought to general attention in this country by Charles A. Bennett in the naming of the Macy Manual Arts Building in New York City in 1896. The influence of Bennett's book, *The Manual Arts*, which was published in 1917, did much to continue the use of the expression over wide areas. He divides the manual arts into several categories: the graphic arts, the mechanic arts, the plastic arts, the textile arts, the book-making arts, and the culinary arts, if more art than science. The Manual Arts Press, of which Mr. Bennett has been the head for many years, and its numerous publications, continues to perpetuate the term. Among the other books from this press which make mention of the expression both in the titles and throughout the content are: *Manual Arts for Vocational Ends* by Crawshaw in 1912; *Teaching Manual and Industrial Arts* by Griffith in 1920; *Manual Arts in the Junior High School* by Roberts in 1924; and *The History of Manual and Industrial Arts up to 1870* by Bennett in 1926. Other publishers and writers helped promote the term.

The Century Company, in 1926, published a book for Friese under the title, *Exploring the Manual Arts*. The Bruce Publishing Company at Milwaukee, Wis., in INDUSTRIAL ARTS AND VOCATIONAL EDUCATION used the term in numerous articles, as did likewise the *Industrial Education Magazine* of the Manual Arts Press. The Bureau of Education at Washington promoted the term, *manual arts*, in many pamphlets, and in 1910 there was started by the United States Specialist in Industrial Education, Dr. William T. Bawden, the Manual Arts Conference. This was composed of the heads of departments representing manual-arts work in the various institutions of the country engaged in the preparation of teachers. This organization still meets annually under the auspices of its original chairman. The membership has extended to most states of the union, though in recent years it has come to be known as the Mississippi Valley *Manual Arts* Conference. The wide influence of this conference has had much to do with shaping policies and curriculums, and had no little weight in bringing the name *manual arts* into general use. While this conference still retains the expression *manual arts* in its title, its members have ceased to use the term either in their writing or in their public addresses except when referring to the past. Their anniversary volume published in 1934 carried the term *Industrial* in its title. Because of reasons set forth later, the term *Industrial Arts* is coming rapidly to supplant the expressions *manual training* and *manual arts*.

While the word *industry* appeared in 1494 to denote diligence, *industrial arts*, according to the *Oxford Dictionary* was first used as an expression by Pope in 1725. The words were used separately much earlier. *Industriall* appeared about 1590 and again in 1640 and meant the product of man's activity in agriculture. *Industrial* came as an adaptation of the modified French *Industruel* about 1835.

Better preparation of teachers brought a tendency to integrate manual work with general education, and students of education began to cast about for a term which would more nearly connote this philosophy.

Bonser (4, p. 50) was the first to give the expression *industrial arts* its present meaning. He wrote in 1912 as follows:

> Industrial arts as a school subject is the distilled experience of man in his resolution of natural material to his needs for creature comfort to the end that he may richly live his spiritual life.

In 1923 (5, p. 5) he gave it this refinement:

Industrial arts is a study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to these changes.

Since Bonser's first use of it, the term *industrial arts* has appeared in the titles of more books, magazines in the field, and magazine articles, than have either the terms *manual arts* or *manual training*. Both professional magazines now use the word *industrial* in their titles: THE INDUSTRIAL ARTS AND VOCATIONAL EDUCATION, published by the Bruce Publishing Co., Milwaukee, Wisconsin, and the *Industrial Education Magazine*, mentioned previously. Griffith (6) wrote *Teaching Manual and Industrial Arts* in 1920; Bonser and Mossman wrote *Industrial Arts for Elementary Schools* in 1923; Vaughn and Mays (11) wrote *Content and Method of Industrial Arts* in 1924; Anderson (1) wrote *A History of Manual and Industrial School Education* in 1926; Bennett (3) wrote *A History of Manual and Industrial Arts up to 1870* in 1926; Smith (9) wrote *Industrial Education* in 1927; Snedden, Warner *et al* (10) wrote *Reconstruction of Industrial-Arts Courses* in 1927; Warner (12) wrote *Policies in Industrial-Arts Education* in 1928; and Prosser and Bass (8) wrote *Adult Education: The Evening Industrial School* in 1930. Magazine articles appear every month now using the term *industrial arts* to the exclusion of the terms *manual arts* and *manual training*.

It has been shown that the connotations of the word *industrial* as used by many writers and speakers, vary considerably but there is also seen an increasing tendency to use it with the word *arts* to indicate present practices. This may be due to the fact that the term was launched by an international educator and scholar. Bonser had gained this recognition and was therefore accepted with little question by leaders in outstanding teaching positions in various parts of the country. The ideals set up by Bonser were in line with leading contemporary educational thought and as the need for general agreement on terminology became more and more apparent there was also a willingness, if not eagerness, to accept his philosophy and his terminology.

While much has been done in national meetings, especially the Manual-Arts Conference, to develop mature papers on the philosophy of industrial arts in education, little has been written on the trends in terminology. In looking over the list of research titles which have been developed in the graduate schools of the country, it is interesting to find that very few have used the word *manual*, while several hundred have used the word *industrial*. Most theses in the industrial-arts field have been written in the last ten years.

A committee composed of Elroy Bollinger of the University of North Dakota, John Fintz and Frank Moore of Cleveland, Dr. William H. Stone and Dr. William E. Warner of Ohio State University, prepared for the meeting of the Western Arts Association which was held in Columbus, Ohio, May, 1933, the following list of definitions:

Industrial-Arts Education

Addition of the word, "Education," to the term *Industrial Arts* is used when referring to a field or program of such work; for example, *Policies in Industrial-Arts Education* refers to a book dealing with the preparation of Industrial-Arts teachers; *Supervision of Industrial-Arts Education* refers to a person employed to supervise Industrial Arts in a city or state program of education.

Practical Arts

Practical-Arts Education is a form of general or nonvocational education which aids or enriches everyday life principally through purposeful *activity*. Its method is typically *doing* things; that is, taking part in activity directed toward some present useful purpose, rather than merely acquiring facts or skills for their own sake, or for possible deferred values. Acquisition and application are concurrent, if not identical. Examples of *Practical Arts* units are dramatics, games, music, and similar participations through which learners find *wholesome* and *durable* satisfactions, including construction of useful articles from wood, metal, clay, cloth, paint, and other like materials. Any subject may be taught as a *Practical Art* if presented so as to satisfy the two major requirements of proximate usefulness through socially purposive experience or participation. *Practical Arts* includes the various subclasses of (major) *Industrial Arts, Household Arts, Commercial Arts, Agricultural Arts* (minor), *Graphic Arts, Musical Arts, Physical Arts, Plastic Arts,* representing the various major and minor areas of both individual and social economic life. Frequently *Fine Arts* is classed as a separate practical art, although really "fineness" is a *characteristic* or *quality* of all the arts, practical and liberal. The term *Practical Arts* is best used as an omnibus term for administrative purposes instead of a name of an object.

Technical Education

Technical Education is a special form of education on secondary school and college levels offered for the purpose of preparing persons in the arts and sciences, the underlying practices in some trades and professions, and to help qualify them to engage in a trade or some branch of productive industry. This type of education prepares quite specifically for the work in the engineering occupations and minor executive positions in industry.

Vocational Education

Vocational Education is a form of practical education the chief purpose of which is to prepare persons fourteen years of age and older for gainful or wage-earning employment; specifically economic rather than generally social. Its minor purposes, however, are of social character, including civic, moral, ethical, health. (Lee and others.) Although broadly inclusive of any type of education and training with economic ends, the Smith-Hughes Act defines Vocational Education as: Agricultural, Home Economics, Trades and Industries, and Commercial (in General Continuation Schools).

Industrial Arts

(13, p. 27) is one of the *Practical Arts*, a form of general or nonvocational education, which provides learners with experiences, understandings, and appreciations of materials, tools, processes, products, and of the vocational conditions and requirements incident generally to the manufacturing and mechanical industries.

These results are achieved through the design and construction of useful products in laboratories or shops, appropriately staffed and equipped, *supplemented* by readings, investigations, discussions, films, visits, reports, and similar activities characteristic of youthful interests and aptitudes in things industrial.

The subject of *Industrial Arts* belongs peculiarly within junior- and senior-high-school areas for such purposes as exploration, guidance, the development of avocational and vocational interests and aptitudes, specific manual abilities, desirable personal-social traits growing out of industrial experiences, ability to choose and use industrial products wisely, all coupled with the aesthetic relationships involved. In general, its purposes are *educationally social* rather than *vocationally economic*, although in the senior high school it may increasingly emphasize vocational objectives in a nonlegal sense, for certain students.

Industrial Arts includes such industrial representations as drawing and design, metalwork, woodwork, textiles, printing, ceramics, automotives, foods, electricity, and similar units, either as separate offerings or in various combinations common to the "General Shop" or "Laboratory of Industries."

The term *laboratory* is more appropriate when the offering is provided upon an experimental or developmental basis, as is commonly done in the junior high school; and the term *shop* may be more appropriate where the work is carried on rather upon the production or economic basis as may be done in the senior high school.

The term *Industrial Arts* is generally displacing the historical but narrower term, *Manual Training;* and in common usage it has substantially the same significance as the term *Manual Arts;* although *Industrial Arts* emphasizes in addition the all-round arts of industry rather than just manipulative or *manual* aspects of artistic construction implied in the term *Manual Arts*.

Two noteworthy publications of 1934 which will have extensive influence on Industrial-Arts policies are the publication by

the Ohio Committee on Education, entitled *A Prospectus for Industrial Arts in Ohio,* and the anniversary volume by the Mississippi Valley Arts Conference entitled *Industrial Arts in Modern Education.* Professional objectives are shown in the former to serve more and more as controls. In this connection, *industrial arts* is thought of as one of the *practical arts* contributing to an enriched basic education; guidance and counseling; manipulative functions; aesthetic and cultural; and exploration.

Laboratory settings to accomplish the objectives for industrial arts began to develop about 1910 with the conception of Bonser as to the place of this work in education. Russell with Bonser conceived the plan of a composite or "general shop," in which a variety of activities were carried on in the same room with different materials, such as printing, woodwork, drawing, metalwork, etc. This has been called the "Russell-Bonser Plan" of industrial-arts organization. Gary, Indiana, has a unique method of having the boys learn by working with workmen in industry, which plan has come to be known as the *Gary plan.* New York City under the direction of Superintendent Ettinger, emphasized the value of learning in unit shops, that is, having different types of activity taught in shops with equipment especially for the type of work done, such as woodwork in a room especially equipped for woodworking. This plan has come to be known as the *Ettinger* plan for teaching industrial arts. Pittsburg (10, p. 5) made a point of combining the Russell-Bonser and Ettinger plans, and thus evolved the *Pittsburg* plan.

The Russell-Bonser plan, while being rapidly adopted in township high schools and small town schools, is also being favored by larger schools because of its educational possibilities in comparison with unit shop activities.

While there are efforts toward uniformity, the foregoing shows that the terminology leading to and representing Industrial Arts has been loosely used. However this may be, the "Industrial-Arts Idea" is rapidly coming to be recognized as connoting something broader and more useful educationally than other terms and is therefore more likely to remain.

Chronology

The following tables show milestones in the development of Manual Training in the United States. The material is taken from Ham (7, 387–391):

Manual Training in Public Normal Schools

Santee Normal Training School, Santee Agency, Nebr.	1870
Cook County Normal School (Private at first)	1883
State Normal School, Whitewater, Wis.	1883
State Normal Training School, New Britain, Conn.	1884
State Normal Training School, San Jose, Calif.	1890
State Normal and Model School, Trenton, N. J.	1891
Normal College of New York	1892
State Normal School, Framingham, Mass.	1893
Westfield Normal School, Westfield, Mass.	1893
State Normal School, Los Angeles, Calif.	1894

Colored Schools of Grammar- and High-School Grades

Atlanta	1865
West Virginia	1867
Hampton	1868
Clinton, Miss.	1875
Knoxville	1879
Nashville	1884
Waco	1885
Wilberforce, Ohio	1888
New Orleans	1890

Early Kindergartens

St. Louis	1873
Milwaukee	1880
Cedar Rapids	1881
Newport	1882
La Porte, Ind.	1883
Philadelphia	1884
San Jose	1885
Augusta	1887
Sheboygan	1888
Los Angeles	1891

Manual Training in Grades

Montclair, N. J.	1882
Peru, Ill.	1883
New Haven, Conn.	1884
Eau Claire, Wis.	1884
Washington, D. C.	1886
Boston, Mass.	1886
Wilmington, Del.	1889
St. Louis	1890
San Francisco	1892
Menomonie, Wis.	1892

Manual Training in Public High Schools

Peru, Ill.	1883
Baltimore, Md.	1883
Eau Claire, Wis.	1884
Philadelphia	1885
Indianapolis	1885
Toledo, Ohio	1885
Springfield, Mass.	1886
Minneapolis, Minn.	1886
Seattle, Wash.	1891
San Francisco	1892

Private Manual-Training Schools

Massachusetts Institute of Technology, Boston	1876
Pennsylvania School of Industrial Arts, Philadelphia	1876
Washington University Manual-Training School, St. Louis	1879
Pratt Institute, Brooklyn	1887
Sloyd Manual-Training School, Boston	1889
Swedenborgian School, Waltham, Mass.	1891
Thorp Polytechnic Institute, Pasadena	1892
Chicago Manual Training School	1893
California School of Mechanic Arts, San Francisco	1895
Lewis Institute, Chicago	1896

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THE WEDGE

A man who does a little more work than he's asked to, who takes a little more care than he's expected to, who puts the small details on an equal footing with the more important ones — he's the man who is going to make a success of his job. Each little thing done better is the thin edge of the wedge into something bigger.

— *London Rotarian*

A Philosophy of Industrial-Arts Education

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A heart-to-heart talk on what should be accomplished in and by the school shop.

When but a small boy on a farm, my mother decided to take me to see the Ringling Brothers Circus, which was to show in a city some thirty miles away. It was August. As I remember it, we got up about three o'clock in the morning, and by four o'clock we were on the road in a buggy drawn by our team of horses, Herb and Harry. The dirt roads were terribly dusty, and by seven o'clock the horses were pretty warm. After what seemed ages, we got to the city and saw the show. It was a great circus then, as it is now, and I enjoyed it immensely. We got back to the farm the following day, having taken roughly thirty-six hours for the trip.

Last summer, my mother, now nearly seventy-five years young, her grandchildren and I went to see that same Ringling Brothers Circus, likewise in a city some thirty miles from where we live. Again we all enjoyed the show, especially the grandchildren and the grandmother. This time the trip took us approximately four hours from the time we left home until we returned. Just one ninth of the time was taken that was required for Herb and Harry.

This leads me to the question as to how much education has improved in the past thirty years. We used to get three thousand miles from an automobile tire that cost twenty-five dollars, and now we get ten times the mileage from a tire that costs one half as much. How much has industrial-arts education improved?

Modern Methods

A couple of years ago in my small city an appropriation was received from the new-deal administration to restore a small artificial lake to its former status. The silt of many seasons had completely filled the bed of the lake, and it had become an excellent eyesore and breeding ground for mosquitoes. The federal specifications called for the work to be done all by hand. After three days of sweating, and blisters and groaning, the engineer calculated that by working continuously eight hours a day, winter and summer, the lake could be restored in approximately three years. Thereupon, after much red tape had been wound and unwound, tied and untied, negotiations were made to secure a steam shovel to load the trucks. The work was completed in approximately three months. The lesson, if such there be, is that progress simply cannot be cut out of the budget. Any firm which neglects progress soon goes into receivership. Likewise, any form of education which is content to go along in the old horse-and-buggy ways is certain, sooner or later, to find itself in the court of obsolescence and bankruptcy.

"This is a new day, and a new philosophy is necessary to solve its riddle." The teacher who taught me my first course in what was then called "manual training" subscribed to a faculty psychology of education. We learned by the joint-exercise method. That was a horse-and-buggy idea of teaching, and it isn't too hard today to find that idea still being used. Not over a year ago, I went into a two and a half million dollar school building. Under the woodworking teacher's desk was a large box filled with cross-lap and mortise-and-tenon joints. The top of the desk likewise had on it nearly all of the joints that it would hold. Horse-and-buggy ideas!

What about jigs and templates handed down to the third and fourth generations of pupils? What about lettering exercises, geometrical designs, and inked tracings? What about the A.V.A. units? To me that Jacob's coat of many colors looks very much like the Russian system of 1876. That was sixty years ago.

"New ideas," said H. N. Casson, "hurt some minds as much as new shoes hurt some feet." I can well remember the year that I took some work under the famous David Snedden. I had been teaching woodwork for six years in a university and had prided myself on how well I could make a joint, or turn a bead with a woodturning chisel, or do a piece of inlay work. To be brief, David Snedden caused me more pain that year than all the new shoes that I will ever get. A lot of what he said was the truth, and five years were required to let that truth soak in.

Yes, we don't like ideas that hurt. But if many industrial-arts teachers don't accept some new ideas, some other education is going to force a lot of educational fossils into bankruptcy. Progress will not be stifled. We must think our way out of the horse-and-buggy days of manual training into a streamlined era of industrial-arts education. To be sure, "Change is wasteful but stagnation is a —— sight worse." The stand-pat man must stand aside for the thinker of tomorrow.

What we have in our nation we must first have in our schools. Industrial-arts education has a rendezvous with the future. If you and I do some serious thinking, we will not fail to be at that rendezvous.

What is Meant by Philosophy

The ordered thinking which we do leads us to certain beliefs. To those beliefs we tack the name "philosophy." Whether we think or not, you and I each follow some philosophy. We believe something if we do anything. Whatever it is that you think, set down your thoughts on paper. If you believe in joint exercises, put it down. I have much more hope for someone, even a horse-and-buggy thinker, if he puts his ideas down. A rudderless ship gets no place, but a ship with a rudder can get somewhere. It may in time find that where it gets isn't where it wanted to go. There is then some hope that, after making enough blunders, that it will get to the right place. "Ideals," said Carl Schurz, "are like stars. You will not succeed in touching them with your hands; but like the seafaring man, on the desert of waters, you choose them as your guide, and following them you reach your destiny."

In this matter of beliefs, like the matter of being guided on the ocean, we must attempt to discover the big unchanging ideas which seem to be true. We are so affected in our daily living by those things which are close at hand. The tiny cinder that we get in our eye feels many times larger than the North Star. Yet that star has remained and will remain for ages to come as a guide for man's destiny.

What, then, are the fixed stars for us in industrial-arts education? Simply stated, one of them is that we must begin with the natural interests of children. It takes much energy to make water run up hill. When we begin teaching on the theory that we are going to make a child learn, or that we will compel him to get his lesson, or that we will force him to master certain units — in whatever way such making or compelling or forcing be done — we are attempting to make water run up hill; we are going contrary to the natural currents of human nature. Similarly, when we set

up a perfectly gorgeous scheme of competition and devise all sorts of progress charts, grading schemes, examinations, brain derbys, paper stars, prizes, honors, ribbons, and loving cups (what a name!), we are going contrary to the natural interests of children. In these events, the pupil's primary attention is centered on the paper stars and on the methods of beating the other fellow rather than on the good that can be done for society.

The Natural Interests

When we say that we must begin with the natural interests of children, a few of the lock-step regimentarians immediately throw up their hands, for they see the children throwing stones at telephone poles, breaking windows and electric lights, and otherwise engaging in harmful and nonsensical pursuits. Nothing like this is true. I can remember a boy who was about six or eight years younger than I who lived across the street from me when I was in college. Those were the days when Lincoln Beachey, one of the pioneers in aviation was doing his stunts. This boy had seen one of the Beachey demonstrations. Immediately, he asked his manual-training teacher — it really was manual training, too — if he could not make a model airplane. Of course, his teacher, not knowing a cockpit from a propeller and not caring to show his ignorance, denied the request. The boy, therefore, took up the activity at home. He was, however, much discouraged by his parents. In spite of the misfit school, with its emphasis on notched chunks of wood, and in spite of discouragement from problem parents, the boy overcame all obstacles. When I heard from him last, he was a successful designer in an aircraft factory in Ohio. The boy had some natural interests. Rather than being hindered all along the line by meddlesome paternalism whose chief joy in life is in compelling children to follow adult life patterns, the boy should have been encouraged to follow his bent for airplanes. Following your natural interests is not mollycoddle learning at all. It is the force that urges you on when the doors of school close behind you; it drives you on when competition ceases; it pushes you forward until life's work is done.

One grave concern of the strait-laced traditionalists is that a boy is likely to miss something; he won't get all the fundamentals. The natural interests of the child may lead him past the multiplication table, or the binomial theorem, or a dovetail joint. To some, this sounds reasonable, but when one reflects — and I doubt that the educational traditionalists are yet aware of this — when one reflects that learning has expanded so in the past century that if any one person was required to get all the fundamentals, he would have to live to be as old as Methuselah, and by that time his goal would be farther away than when he started.

Put a normal, active child in a normal school, home, or community situation and what do we notice? We notice that he loves to discover. Whether it be a ball, a top, a yo-yo, a sewing machine, a pair of scissors, or an electric fan, the child has to find out just what it is all about. He loves to discover his world, and he usually remembers what he discovers.

I can remember when but a boy of thirteen, my father brought home a one-horsepower gasoline engine with which to turn the washing machine, run the water pump, and otherwise do some of the mechanical chores on the farm. My father was not interested in mechanical things, so it fell to me to operate the engine. I looked at the instruction sheet which came with the engine, but it was as interesting as a Chinese newspaper to a Frenchman in love, so I proceeded to discover how that engine worked. One of the first things that I discovered was the spark plug. That was one of the most thrilling events of my life. Imagine, if you can, anything as innocent as a spark plug being thrilling, but it certainly was to me. You see, I was discovering things.

Now, I'll admit that a chapter or two on the theory of electric currents, a half dozen graphic-analysis diagrams on various methods of internal-combustion ignition, a long list of do's and don't's, and a true-false test of several pages would have been wonderful if such were in existence in those days — but for me, I still cherish that spark-plug discovery. I remember that gasoline engine. I could right now almost take it apart and put it together blindfolded. This has resulted because I followed my natural interests. "The great end of life," said Huxley, "is not knowledge but action."

Again the thumb-twiddling traditionalists object by saying, "Yeah, that theory of natural interests sounds fine, but look at what it does to the organization of my subject matter." The answer is that, "If the natural interests of children continue to be thwarted by subject matter and organization, then let them b[illegible] . . ." Well, as some of you know, the [illegible] language is tremendously inadequate at times to express one's thoughts. For growing children, natural interests come first. We may some day discover that for adults as well. "The fundamental instinct of life," says H. G. Wells, "is to create, to make, to discover, to grow, to progress."

Children must do their own thinking in this world, and they will, too, if we place them in situations which challenge their natural interests. Give a child of six to fifteen a sunglass, then watch her or him experiment; watch the wheels of the brain go 'round. Give the child a horseshoe magnet and some pieces of various kinds of metal. Then watch the thinking that is put forth. Give the boy of fifteen a second-hand gasoline washing-machine motor and a coaster wagon and watch the thought take form.

When placed in lifelike situations, we like to do our own thinking, and we love those who do their own thinking. The story is told of a lady who during her courtship was for a long time convinced that she did not care for the Romeo who wooed her. Finally, one day, she received a perfectly wonderful love letter from him, and subsequently they were married. Twenty years later he died. In going through one of his old trunks she found a book on "How to Write Love Letters." On a certain page which had the corner turned down she found a printed form of the letter which came to her twenty years previous. Better for the man, had he been living, that a millstone were hanged about his neck.

Again, the black-gowned disciples of formalism will say, "Yes, that idea of natural interests is fine for those who are bright, but it just will not do for the numbskulls." Is that true? Does water run one way in the valleys and another in the mountains? Some think so, but they are only deceived. The sluggish water of the lower Mississippi seems not to be moving, but nevertheless it is surely and relentlessly finding its way to the gulf. The natural interests of the dullard seem at times to have no direction, but just as surely and truly they are seeking expression according to natural law. "Successful teaching," says Prosser, "is essentially a process of working with, instead of against, the mind in its operation."

Because the dullard looks steadfastly at an instruction sheet or bores a hole through you while you are giving a lecture is no sign that learning is taking place. Under the formalized methods of teaching, the dull can appear bright, and the bright already "knows it" so he gets into all sorts of devilment.

The yearly number of patents per capita in the United States has not increased during the last half century. When one considers the great increase in education, this is certainly a reflection on the mummified formalism of our schools.

A couple of years ago, a prospective graduate student came to me. He had a four-year degree from a college of the Middle West, and had taken twelve semester hours of industrial arts so as to qualify him for teaching. In the course of our talk, he said, "Do you know, I really don't need a master's degree; they're nice to have, but I really know all that is necessary to

teach industrial arts." It so happened that I had had a good breakfast that morning, and I did my best gracefully to speed the contented creature on his way. These days, "A fellow who knows it all has a lot to learn."

No matter what field of work we are in, if we can't see problems and things to be done, we had better make out our last will and testament and buy a small plot of ground out on a hill some place where we can be with others of our kind. Because of our pill education from the grades on up, we are satisfied with hearsay, copy-book, job-sheet learning. Let's get industrial-arts education out of that ignominious, infernal rut. Real education is not a peddler of second-hand facts and ideas; real education is essentially a discoverer, a pioneer, an inventor, a trail blazer. The more that industrial-arts education becomes jigged and fixtured, the less does it become real education. Let's stimulate pupil's inherent interests, let's feed the natural springs of living curiosity so that every citizen of the United States, young and old, shall continue to make his contribution to the progress of both himself and society.

The dogma which ushered in manual training fifty years ago was expressed in the verse, "If hand and eye you deftly train, strong grows the will and keen the brain." The matter would be humorous if it were not for the fact that the treadmill dogma is all too prevalent now. Such an idea may serve in a country ruled by a dictator, but it will soon rot the heart out of a democracy. Ability to think through life problems is not imparted either by rote memory procedures or by assigning tasks in which the essential thought processes have already been done. The watermelon eaten by the other fellow does us little good; likewise with thinking. We eat canned oysters only when there's nothing else to be had, and we don't like canned thinking any better.

A school today which is fit for pupils to live in is a school which gives its pupils something challenging to do. "When the fight begins within himself," says Browning, "a man's worth something." Rousseau, whose philosophic dynamite rocked the world, said, "Life does not consist merely in breathing, but in action." Too many of our schools want children to be little angels and do nothing but breathe. What is it that makes Hans and Fritz, the Katzenjammer kids of funny-paper land, so interesting down through the years? It is because they have some natural interests for which normal outlet is not provided. The resulting conflicts are so true to life that both young and old understand.

A contractor was laying a concrete sidewalk. He had finished and was picking up his tools. Along came a couple of boys and made some footprints in the soft material. The contractor was reading the "riot act" to them just as an old gray-haired lady came along. She stood a moment and then said to the man, "It must be that you don't love boys." The contractor thought a second and then replied, "Madam, I like boys in the abstract, but I don't like them in the concrete." Now, if we are to be industrial-arts teachers we must like boys as they are and through encouragement and example help them become what they ought to be.

It takes a much bigger teacher to direct natural interests than to maintain army discipline. To have pupils disagree with the teacher and do some original thinking throws many teachers into a rage. Yet, to think is more important than to agree. As never before the world needs men of thought and action. The mollycoddle education is the old type, not the new. "The ultimate testimony of science," says L. P. Jacks, "is a revelation of the whole man as essentially a creator." It is necessary then to do some real thinking, and to create a type of industrial-arts education which will make a greater generation of humanity tomorrow.

Building the Social Order

Another of the guiding stars of our beliefs is that industrial-arts education must consciously attempt to build a better social order. Tomorrows in the lives of nations are no more accidents than they are in the lives of individuals. As a nation united, we must build for a better tomorrow. The most successful tomorrow is planned today. The person who ridicules the thought of a better social order is he whose grandfather ridiculed Edison, Bell, and Ford. The self-satisfied senility of the stand-patter is most amazing. The story is told of Carlyle, the hardheaded Scot, who sat listening to a group of old-timers belittle a man of the community who had expressed some Utopian ideas. Carlyle stood it a while, but when a pause came, he said, "Gentlemen, there was once a man whose name was Rousseau. He was foolish enough to write a book which was nothing but ideas. He was ridiculed and made the subject of much jest. But the hides of those who ridiculed him went to bind the next edition of that book."

Up until 1930, the people of the United States were so busy betting on the stock market that the idea of a better society never occurred to them. Only within the last three or four years has any person in public position dared to criticize the chaotic order or to venture a suggestion for improvement. It might affect the quotations on Cities Service, or Bethlehem Steel, or Sauk Center Sewage. "In this land of endless opportunities," so everyone thought, "there could be nothing very much wrong. This was God's country."

What a fall from grace! The clumsy elephant was deserted for the braying donkey; the bond salesman with a degree from Harvard was discovered washing dishes; and the fellow who had built a two-car garage started walking.

"Eternal vigilance is the price of democracy." Where shall that vigilance be maintained, you ask? It shall be maintained in the public school. What subject should be responsible for such vigilance, you ask? It should be kept by all subjects, by all pupils, by all teachers, by all institutions, young and old alike. The lamp of democracy burns not brightest in the nation's capitol unless it burns in the heart and life of every person in the United States. "The only sure thing we face," said Dewey, "is change." Whether a better social order is discussed in a social-science class or in industrial arts makes little difference so long as thereby the light of democracy is made to burn more brightly. The task is sufficiently large that should the whole school solve the problem there would be enough glory for all the departments and much left over. "True life experiences," said Friese, "do not come to men departmentalized."

The older philosophies of education have been built on the supposition that whatever existed must be all right, but the truth is that "what exists is seldom a criterion of what should be." Let's scrap this idea of analyzing adult society and deducing therefrom what ought to be in our public schools.

Says H. G. Wells, "Schools should be miniature copies of the world we should love to have."

Individualistic capitalism has been fostered in our public schools. Have we not all preached about "the money value of an education"? Money, Packards, diamond rings, fur coats, and seats on the stock exchange were the measure of success! Some husbands with their multidivorced wives beshackled with huge diamond rings remind one of the lady who bought a fifty-cent mongrel pup and then got a five-dollar collar to put around its neck. Just recently I attended a college convocation in one of our larger institutions of higher learning. Three of the seniors were being awarded scholarships of $600 each to be used for continued graduate study in any outstanding university. The president explained that the awards were given because of manly character, proved ability, and professional promise. As the three boys walked off the platform after having been given the awards, I heard a masculine voice back of me say, "Gosh! There walks away eighteen hundred bucks."

It will take the people of the United

States decades to learn that the men who have done the most for the world have worried least about financial rewards. Somebody says, "Yes, but we are better off materially than any country in the world." Granted. But when we consider all our potential possibilities we represent a pretty sorry failure. Like the model-T Ford of 1916, it is a mighty good Lizzie, but it has a long way to go before it will look like a Zephyr.

But then you ask, "Just what are the social problems which should be studied in a school?" The answer is, "Any that will tend to produce a better society." Capital is getting along with fewer and fewer laborers per unit of goods produced. On the other hand, consumers, who have been displaced by machines, have no money wherewithal to buy. Some would solve the problem by abolishing the machine. What folly! Science is not thus thwarted. Some would take the money away from the capitalist and give it as a dole to the common man. Again, what folly! Aye! Yes! What nonsense for any one man, any one teacher, howsoever ignorant or wise to assay the answer. Let the public-school children of the United States study the problem for twenty years, and we will have the answer. Let them study all sides of all of the social questions. Somewhere between the views of the conservatives and those of the radicals must lie the truth. That truth shall come from a continuous consideration of our destiny in constructing a better social order.

There is the multiheaded monstrous problem of competition or opposition between groups and blocs: The farmer *vs.* the city dweller; the mills of New England *vs.* the mills of the South; the orange growers of Florida *vs.* those of California; the coal miners *vs.* the operators; the consumers *vs.* the producers; the railroads *vs.* new methods of transportation; the farmer *vs.* the insurance companies; the holding companies *vs.* all-comers; and so on. We may as well face the truth. Competition is our own Dillinger graduate of our schools and colleges. Have we not taught competition in games, honors, progress charts, grades, brain derbys, contests, athletics, and in nearly every act of school life? By fair means or foul, children have been taught to bring home the bacon. Are we reaping what we have sown? Frankly and emphatically it is my opinion that we are. Competition doesn't happen any more than Canada thistles happen. For every phenomenon, there is a cause.

A greater, finer society can never be built on competition. Even the savage learned that lesson. He compromised, he united; at least those did who survived. Every person in these United States, and some day we hope in the world, should be pulling his fair share of the load. "The fellow who is pulling on the oar has no time to rock the boat." "Cut-throat competition," said someone, "is recorded in red arithmetic." Yes, and it will be recorded in red blood in America in the not distant future unless the children in our schools study and understand our social problems. We are all human and what we need in this complex society is to understand the other fellow's difficulties.

A father was in a pullman car with a nine-months-old baby boy. About 10:30, when everyone was ready to retire, the baby suddenly began crying and kept everyone awake for some time. Finally, a traveling man could stand it no longer. From behind a curtain, he swore at the man and said, "Why the h—— don't you keep that brat quiet?" The father hesitated a moment and said, "I — I wish that I could, but I can't. His mother could if she were here, but — but she is back there in a box in the express car." The traveling man thought over what he had said, then got out of his berth, came and asked the man's forgiveness, talked with him a while, then went back to the dining car, got a bottle of milk, had it warmed, brought it back to the baby and it was soon fast asleep.

Yes, in America, we don't understand one another's problems. In college, we're too busy chasing marks and hoarding credits, and in life we're too busy chasing happiness and hoarding dollars. If the city man knew what a bushel of corn or a quart of milk cost in actual labor, he would look at the problems of the farmer differently. And so on for all the groups which are fighting the other fellow instead of helping to build a greater United States and a better world.

(To be concluded)

100 Hobbies for the Junior-High-School Boy

Burton T. Williams

Beloit, Wisconsin

An interesting list of hobbies and references for the teacher who wants to help his students in preparing for using their leisure profitably.

Happy is the boy possessing or possessed by a hobby. In this day and age, it is well to look to the hobby as a worthy use of leisure, and one of the greatest aids in developing interests and abilities of children. The idle child is one who becomes bored and will seek pleasures by lavish spending or with undesirable companions. "Worthy use of leisure," is one of the objectives of our educational system.[1] There is a tendency toward a greater amount of leisure for everyone. Proctor[2] says, "In every field of human endeavor, labor-saving devices tend to reduce the necessity for long hours at tasks requiring strenuous physical exertion." The hobby is one answer to this problem.

A hobby may be considered a form of play, and yet be indulged in with all seriousness. There are many types of hobbies. Some people's pet hobbies may seem like bad habits to others. All hobbies, however, stimulate individual action and develop wholesome curiosity. A desirable hobby will supply at least one of the following values. It will furnish pleasure, satisfaction, pride, enjoyment, and probably the most important, a worthy use of leisure.

If parents would spend a little effort and time with the boy of the teen age, and give him a little helpful co-operation, encouragement, and a small investment in tools and equipment, they would uncover many hidden secrets of the boy's nature, and build up a valuable companionship for later years.

There are many possibilities for encouraging the junior-high-school boy to adopt a hobby. Parents and teachers can indirectly guide children into the pursuit of worth-while hobbies. The industrial-arts work of the junior high schools also presents these possibilities. The shop teacher should be ever on the lookout to encourage the boys toward this end.

[1] Bobbitt, F., *How to Make a Curriculum*, Houghton Mifflin Co., Boston, Mass., 1924, p. 219.

[2] Proctor, W. M., *Educational and Vocational Guidance*, Houghton Mifflin Co., Boston, Mass., p. 197.

One of the most engaging hobbies of the teen age is reading. Here we find the public library as a most active stimulant to this constructive type of leisure activity. Langmuir[3] in his article, "Values of Hobbies," tells of a hall in the Memorial Science Building, in Pennsylvania, which is known as Hobby Hall. Here, if a boy is interested in heavy machinery, he may work among lathes and printing presses, which are found in the basement. If he is interested along other lines he may go up to the meteorological laboratory or the observatory, where he can work with small telescopes. On the way, he can stop and dabble in photography, motion-picture experiments, and airplane work, and what not. On the top floor he can draw, paint, model, or cut linoleum. He is offered opportunities to his instincts for self-expression. There is an instructor in constant attendance, watching for new genius which can be turned over to the colleges for development.

This is the first attempt in America to *capitalize hobbies educationally.*

Another possibility for the encouragement of hobbies is through civic organizations, such as youth organizations, boy scouts, and clubs. Many of these clubs sponsor pet and hobby shows each year, in which many interesting and worth-while hobbies are displayed. These shows act as a challenge to the boys to develop interests and abilities to the highest degree. There are many benefits to be derived from a hobby. Many are distinctly educational, and encourage a person to learn. Reading, literature, astronomy, and music are all examples of this type.

Photography, for instance, offers many different fields of interest to tempt the imagination and ingenuity of the individual. It also broadens his knowledge and brings him in contact with a fine art. W. B. Miller's[4] article, "Photography as a Hobby," compares the values obtained through photography with other hobbies, and brings out the fact that it uses many intellectual values and possibilities that do not exist in other hobbies.

The craftwork hobbies train the eye to recognize beauty of line and harmony of color. They give balance to an intellectual person, and test his accuracy and skill. They develop industry and neatness, and provide relaxation.

Collecting anything is a healthy human impulse. The longer and harder he must search for his desired possession, the greater the joy when it is obtained. There is much knowledge to be obtained through collections. For example, the collection of stamps and coins, motivates the boy to learn much of geography and history.

The junior-high-school years are years of exploration in hobbies. Very few boys of this age pursue one hobby for any great length of time. But the field of hobbies is large enough to accommodate the changing interests of these boys.

This article shows the varied fields from which a boy may choose his hobby. It contains also, one or more selected references for each hobby, to assist the boy in making his choice.

Outdoor Hobbies

1. Baseball

Harris, S., *Playing the Game,* A. Stokes Co., New York, 1925.

Bush, J., "Lost Arts in Baseball," *Saturday Evening Post,* 202:54, April 5, 1930.

2. Boating

Erickson, W. W., "Boat and Trailer Add to Your Camping Pleasures," *Popular Mechanics Magazine,* 50:1030, June, 1931.

3. Camping

Dimock, H. S., *Camping and Character,* Association Press, New York, 1931.

4. Fishing

Beard, D. C., *Fishing,* J. B. Lippincott Co., Philadelphia, 1925.

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Conclusion

It is true that many times a hobby will turn into a vocation, or some new discovery or invention will result, but if the hobby serves to keep the boy interested and well occupied during his leisure time and gives free play to his instincts for self-discovery and expression, it will have proved itself invaluable. Leisure time wisely planned is an essential factor in the happiness and welfare of everyone.

Occupations in the Commercial Letterpress Printing Field

R. Randolph Karch

Arsenal Junior High School,
Pittsburgh, Pennsylvania

The all-around printer of yesterday is gone. The old-timer who used to make his own rollers, wood type, and inks has long since passed away. Specialization is now the keynote in commercial letterpress printing.

In such a specialized trade, there may be found a good many lesser trades, or skills. These have been broken up into units, as shown in the outline presented herewith. An attempt has been made to show the work, educational and physical requirements, the compensation in each, and the promotional possibilities.

The compensation for each branch of the trade is based on the Pittsburgh hourly wage averages, on the basis of a 40-hour week. The same can be done easily in any locality.

The general physical requirements common to all the occupations are: (1) no lung diseases nor a tendency toward them, (2) good eyesight, (3) the ability to work indoors.

Educational requirements common to each occupation are: (1) ability to read written directions accurately, (2) average intelligence, (3) ability to work well with others, and (4) ability to do simple arithmetical figuring.

Boys who decide on learning the printing trade often do not know in what particular branch they expect to work later on. This information, in the hands of the instructor or vocational adviser, may be of help to these boys.

A type of vocational-guidance information which is needed, and which every shop teacher should help to secure.

Hand Compositor

Compensation, $45

Work

1. Compose all types of commercial printing
2. Assemble (make up) machine-cast slugs and types
3. Proof and distribute the job

Educational Requirements

1. Artistic ability and knowledge of good typography
2. Working knowledge of English and grammar
3. General knowledge of lock-up and presswork

Physical Requirements

1. Ability to stand for long hours at work

Promotion Possibilities

1. Shop foreman
2. Layout man, typographer
3. Superintendent

Stone Man

Compensation, $45

Work

1. Lock up simple forms and any page imposition

Educational Requirements

1. General knowledge of composition and presswork

Physical Requirements

1. Ability to stand for long hours at work
2. Sufficient strength to lift heavy forms and chases

Promotion Possibilities

1. Foreman
2. Superintendent

Machine Operator

Compensation, $45

A. Linotype Operator and Monotype Keyboard Operator

Work

1. Compose straight matter and job composition
2. Take care of minor machine troubles

Educational Requirements

1. A working knowledge of English, grammar, division of words, etc.

Physical Requirements

1. Ability to sit for long hours at work

Promotion Possibilities

1. Foreman
2. Superintendent
3. Machinist-operator
4. Layout man

5. Trade compositor

B. Monotype-Caster Operator

Compensation, $45

Work

1. Care of all casters — machine changes, etc.
2. Casting of composition, sorts, strip material

Educational Requirements

General

Physical Requirements

1. Ability to stand for long hours at work

Promotion Possibilities

1. Foreman of caster room
2. Superintendent

C. Ludlow Operator

Compensation, $45

Work

1. Composing all classes of work on Ludlow typograph

Educational Requirements

1. Same as linotype operator

Physical Requirements

1. Ability to stand for long hours at work

Promotion Possibilities

1. Foreman
2. Superintendent
3. Layout man
4. Typographer
5. Trade compositor

Linotype Machinist

Compensation, $50–$60

Work

1. Mechanical care of linotype machines

Educational Requirements

1. Machinist training of a general nature
2. Ability to write orders for parts, etc.

Physical Requirements

General

Promotion Possibilities

1. Foreman
2. Company machinist
3. Superintendent
4. Erector
5. Trouble shooter

Platen Pressman

Compensation, $41

Work

1. Printing all work on platen presses of all makes
2. Cutting paper stock (in small shops)
3. Simple binding operations

Educational Requirements

1. Mechanical knowledge of platen presses
2. Simple arithmetic

Physical Requirements

1. No color blindness
2. Ability to stand for long hours at work
3. Sufficient strength to lift heavy forms

Promotion Possibilities

1. Pressroom foreman
2. Superintendent

Cutter

Compensation, $40

Work

1. Figuring and cutting paper stock

Educational Requirements

1. Accuracy in figuring arithmetical problems

Physical Requirements

1. Ability to lift heavy paper stock

Promotion Possibilities

1. Pressroom foreman

Cylinder Pressman

Compensation, $44

Work

1. Printing all types of work on cylinder presses
2. Cutting paper stock (in small shops)
3. Simple bindery operations

Educational Requirements

Same as platen pressman

Physical Requirements

Same as platen pressman

Promotion Possibilities

Same as platen pressman

Rotary Pressman

Compensation, $50

Work

1. Printing all types of work on rotary presses

Educational Requirements

Same as platen pressman

Physical Requirements

Same as platen pressman

Promotion Possibilities

Same as platen pressman

Layout Man or Typographer

Compensation, $60

Work

1. Create designs for all types of printed matter
2. Draw layouts for printed matter
3. Mark up layouts for typesetting and assembling

Educational Requirements

1. Knowledge of good modern typographic principles
2. Comprehensive knowledge of all type faces
3. General knowledge of all printing processes
4. Simple arithmetic

Physical Requirements

1. Ability to work on sedentary job
2. No color blindness

Promotion Possibilities

1. Superintendent
2. Foreman
3. Artist
4. Type designer

Proofreader

Compensation, $45

Work

1. Correct proofs with original copy
2. Query copy errors to author
3. Edit copy

Educational Requirements

1. General type of academic education
2. English grammar in its entirety
3. Knowledge of foreign languages
4. General knowledge of all printing processes

Physical Requirements

1. Ability to read through the working day continuously

Promotion Possibilities

1. Foreman
2. Superintendent
3. Editor
4. Lexicographer

Printing Salesman

Compensation, Salary unlimited

Work

1. Call upon and sell buyers of printing
2. Create printing jobs and submit to buyers
3. Study buyer's business and suggest forms, selling pieces, and the like

Educational Requirements

1. General type of academic education
2. Business knowledge
3. Salesmanship
4. General knowledge of all printing processes

Physical Requirements

1. Ability to make many calls a day on customers
2. No color blindness

Promotion Possibilities

1. Sales manager
2. Superintendent
3. Proprietor

Printing Engineer

Compensation, Salary unlimited

Work

1. Act as "efficiency expert" in printing plants
2. Make changes in plant for economy, mechanical improvements

Educational Requirements

1. Good knowledge of all printing processes
2. Ability in time study methods
3. Good knowledge of materials used in printing
4. Ability to plan layouts for plant efficiency

Physical Requirements

General

Possibilities for Advancement

1. Consulting engineer
2. Proprietor

Estimator

Compensation, $70

Work

1. Bid on jobs of printing

Educational Requirements

1. Good background in mathematics; ability to figure accurately
2. Knowledge of all printing processes
3. Ability to study hour costs in production

Physical Requirements

1. Ability to work on sedentary job

Promotion Possibilities

1. Superintendent
2. Foreman
3. Printing Engineer

Pressfeeder

Compensation, Cylinder $30
Platen $25

Work

1. Feed cylinder and platen presses
2. Assist pressman

Educational Requirements

General

Physical Requirements

1. Be able to stand for long hours at work
2. No color blindness

Promotion Possibilities

1. Pressman
2. Pressroom foreman
3. Superintendent

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INDUSTRIAL ARTS and VOCATIONAL EDUCATION

J. J. Metz, Editor

The Tracing Supplement

For many years, the INDUSTRIAL ARTS AND VOCATIONAL EDUCATION MAGAZINE has furnished a tracing supplement each month to its readers. The Post Office Department, however, has informed us that henceforth this helpful teaching aid may no longer be issued, as it ". . . is not a permissible inclosure as a supplement or otherwise in copies of the publication mailed at the second-class rates of postage. . . . Moreover, it is not contemplated that supplements shall be a regular feature of a publication of the second class."

We were furthermore informed that even the stapling-in of the tracings would not satisfy the requirements, as they would not only have to be stapled with the rest of the magazine, but also would have to be printed on regular magazine stock.

The Bruce Publishing Company was loathe to discontinue a service which it has so long rendered to its readers. The problem was therefore carefully studied, some experiments were made, and a comparatively simple solution was obtained. The monthly tracing, therefore, will not be discontinued. The one in this issue will be found on pages 334a and 334b. It has been placed in the middle of the magazine so that all that is necessary to remove it, is to open the staples. Of course, after the sheet has been removed, the staples should again be closed in order to hold the rest of the magazine together. Then, to make the tracing transparent, rub the back of it with a cloth moistened with any of the various kinds of cotton-seed or corn oils. The process is quite simple and the blueprints made from a tracing treated in this way will be found to equal in every way those made from the old tracing supplements.

James Watt

Probably no more interesting biography can be offered to the student of industrial arts and vocational education than that of James Watt, the father of modern steam engineering. Practically every boy has read one or the other version of how James Watt discovered the force stored up in steam by watching the cover on his mother's teakettle bob up and down, and how from this discovery the steam engine finally evolved. Several artists have made this story the subject of their paintings, and although there is no historical proof to substantiate the tale, it persists and is retold again and again in the languages of many countries.

By some, Watt is even called the inventor of the steam engine, yet this can hardly be maintained, as there were several types of engines operated by steam in use before he began his experimentations with this form of prime mover. He does, however, deserve the greatest credit for perfecting the steam engine so that it made possible the almost miraculous changes which have produced our present mechanical age. Due to his keen mind, industry, and ingenuity, the steam engine, which up to his time had been used merely for pumping water, was improved, adapted, and applied to other types of work. In this way, he affected and speeded up industry, invention, transportation, manufacturing and building methods, and commerce. His work, probably more than any other man's, has made industrial arts and vocational education a necessary part of the education for the youth of today.

James Watt was born January 19, 1736, in the small seaport town of Greenock in Renfrewshire. His father, also named James, was a carpenter who built ships as well as houses; carved ships' figureheads; made pumps, gun carriages, capstans; repaired nautical instruments; was a ship chandler, a merchant, and was elected bailee of his home town.

While James was the sixth child born to James and Agnes Watt, he was the eldest surviving child, the first five having died in infancy. James was weak and sickly, and for that reason was unable to attend school so early as other boys of his age, and even after entering school, his attendance was irregular because of ill health. The early training given him by his father and mother, however, was an effective substitute for that which he missed by not attending school, It is interesting to note that his father had a very modern idea of the right type of education to be given to his son for he saw to it that the boy had access to the use of tools, and James, sickly though he was, became quite skillful in their use. These tools helped him to lay a foundation for making the experiments which were necessary to perfect the many inventions which he produced in later life. In this way, also, he acquired the skill to repair the telescopes, quadrants, and other nautical instruments that came to his father's shop. When he did go to school, he acquired Latin, Greek, and considerable mathematics.

At the age of eighteen, he went to Glasgow with the idea of preparing himself as a mathematical-instrument maker. Here he lived with some of his mother's relatives, one of whom was a professor at the University of Glasgow. Through him, he became acquainted with Dr. Dick, professor of natural philosophy, who became interested in young Watt. It was he who urged Watt to go to London rather than to stay at Glasgow, to learn the trade of instrument maker. Following Dr. Dick's advice, he set off for London on June 7, 1755. After considerable trouble, he finally was able to make arrangements with a Mr. Morgan for a year's instruction in the trade. So well did he apply himself that he quickly became the equal of apprentices who had served several years at the trade, and at the end of his brief term of learning, he returned to Glasgow. The instrument makers of Glasgow, however, would not employ him because he had not served the usual seven-year apprenticeship. Fortunately for him, his friends at the University of Glasgow came to his help at this time. The University had just inherited the instruments from an observatory located in India. The sea voyage affected the iron parts of the instruments considerably, hence, Watt was commissioned to put them in condition for which he received the payment of five pounds sterling.

He then tried to open a shop of his own in Glasgow, but this was not permitted him since he had not served an apprenticeship and was not a citizen of Glasgow. Again, the University came to his rescue, and the summer of 1757 saw him established in a shop of his own on the University grounds with the title of "Mathematical-instrument maker to the University."

In 1759, he went into a partnership with John Craig, and by 1764, the firm was employing 16 men. In 1765, this partnership was dissolved by the death of Mr. Craig. Watt's reputation as an ingenious mechanic had by this time become so well

established that he was even commissioned to build a large organ, and to repair numerous smaller musical instruments, although he was not gifted musically himself.

It was probably in 1764 that Watt was asked to repair for the University of Glasgow, a model of Newcomen's steam engine. As usual, his work on this engine prompted his nimble mind to busy itself with the problem of improving that on which he was working. He noticed how Newcomen's engine was most lavish in the use of steam. His thoughts led him into an almost endless maze of experiments in which he discovered the ratio of expansion of water when turned into steam at atmospheric pressure, the latent heat of water, the need of keeping the cylinder walls as nearly as possible at the temperature of the incoming steam, and the advantage of using steam pressure rather than that of the atmosphere. All of these experiments required the making of many models and hence much time. Watt was not a rich man; he had to work for a living. He, therefore, associated himself with a Dr. Roebuck, who, because steam engines were employed in his collieries, was much interested in experiments to make their operation less costly. In order to make both ends meet, Watt had to interrupt his experimentations again and again, to take care of extended jobs of surveying, many of which seem to have been assigned to him about this time.

In the meantime, Dr. Roebuck had financial troubles which also hampered the progress of the work. However, progress was made, and in August, 1768, Watt went to London to take out patents on his engine, and these were granted on January 5, 1769, for "A new method of lessening the consumption of steam and fuel in fire engines." Surveying jobs again intervened and several years elapsed before Watt could go back to his engine. By this time the patent granted on the engine had only eight more years to run. He therefore applied to parliament for an extension, and in May, 1775, the patent rights on Watt's engine were extended for twenty-five years. On June 1 of the same year, much to Watt's joy, the partnership with Matthew Boulton, who owned a great factory at Soho, near Birmingham, was finally consummated. Boulton was a very energetic man and under his constant urging, Watt planned two large engines, one with a 38-inch and the other with a 50-inch cylinder. Both of these turned out successfully and orders for other engines followed quickly. But many more details had to be worked out before he succeeded in adapting the steam engine, which up to that time had been used only for pumping water, to other power requirements. The success of Watt's engine had by this time caused other engineers to enter this field of endeavor and to make experiments of their own. One of these patented the application of the crank to the steam engine, and so Watt had to find a substitute. He solved this problem by adopting the sun and planet gear until the patent on the application of the crank had expired. Then he too adopted the crank.

Other improvements followed, among them being the use of the steam expansively, the use of a parallel motion in order to make the piston rod move up and down in a straight line, and similar devices. He also had to establish a common measure upon which to base the capacities of the engines which were being manufactured. It was he who determined the horse power equivalent of 33,000 pounds lifted one foot high in one minute.

In 1788, Watt applied the centrifugal governor for the first time to his steam engine. He also studied and worked on the problem of smoke prevention. To check the performance of the engines that were being built he invented an indicator which embodied the same features that are found in the indicators of today. In the meantime, too, the steam engine had been turned into a double-acting machine, and cast iron had replaced the wood so commonly used in the older types. The invention of the steam engine must not be looked upon as Watt's only contribution to mankind, for he was the inventor of many other, though minor, machines and appliances.

At the age of sixty-four, Watt retired. The patents on his steam engine had expired, and he had amassed sufficient money to live at ease. Besides this, his son had succeeded him in business and the elder Watt retired to his estate, Heathfield, near Birmingham. But his inventive urge was not dead. In a workshop which he fitted up in the attic of his house, he constructed a proportional sculpturing machine, the principles of which are still used today.

The wealth that he had acquired permitted him to travel extensively. Honors, too, were conferred upon him. He was elected Fellow of the Royal Society of Edinburgh in 1784, member of the Batavian Society, Rotterdam, 1787, the degree of doctor of laws was conferred upon him by the University of Glasgow in 1806, and the French Academy elected him as a member. He was also offered a baronetcy but he declined this honor.

He died at Heathfield on August 25, 1819, at the age of 84. He was buried in the Handsworth Parish Church beside Boulton with whom he had been in business for so many years.

To the student of industrial arts and vocational education, the life of James Watt demonstrates clearly how advantageously a knowledge of mathematics and science can blend with skill in the use of tools and materials in devising methods for making easier the work of man in wresting a livelihood from the earth. It shows also what may be accomplished by one possessed of a frail body, if he has the will to apply himself steadily to the solution of a problem. A glance at what is happening today in the field of invention should prove to any student that a young man's possibilities today are as great or greater than in Watt's day if one is but willing to emulate the examples of industry and application set for him by James Watt.

A Special Objective for the Year

The school year has already started. The more or less anxious moments of the first few days have been successfully overcome. The machinery of teaching seems to be working smoothly and with precision. The relationship with the new and old students has already been established. Everything seems to be advancing in the right way.

There may, however, be something else that may be inaugurated, probably a special objective for which to work during the coming year. For instance, has the safety question been covered as fully as it ought to be in the regular lesson assignment as planned? Safety is an extremely important factor in industry today. Probably a little more emphasis will help to give the students a better concept of safety.

Have the possibilities of the club idea as applied to the students in one's own class, and in the other classes of the school been thoroughly studied? Some teachers have had wonderful results with their club work. The value of industrial arts and vocational education has received greater impetus because of the work accomplished by the industrial-arts teachers with various clubs throughout the country. The idea may have possibilities for your school also.

Has the home shop received the attention it deserves? It is well to start out the boys on this excellent hobby trail. If they can be interested in a home shop, humble as it may be, much will have been gained in the way of future crime prevention. Then, too, the boy's home shop will bring the parents, especially the fathers, and the school into a closer relationship, and through them the community may be easily reached.

What will be your special objective this year?

What Do Employers Expect Boys Entering the Trades to Know?

Lillian Shuster

Director Extracurricular Activities,
Senior High School,
Ponca City, Oklahoma

A method of adapting the work of the high schools to the need of the community.

The public high schools are endeavoring more and more to prepare today's youth for life in the adult world of today and tomorrow. This necessitates that high-school courses be revised and supplemented to fit the needs of the greatly increased enrollment, most of which represents students who will not pursue their education beyond the secondary school.

To meet this need, many high schools have swung away from the almost strictly cultural and college-preparatory course and are setting up standards for granting diplomas of various types. For several years Ponca City has granted a college-preparatory, a general, and a trade diploma, each with its own requirements.

The trade school, which has a new building on the campus, is growing rapidly. Machinery, electricity, drafting, and woodwork are the four courses taught at present.

In order to make the training received in the trade courses better fit the needs of the student, the trade instructors have recently made a survey of the occupations in Ponca City and of the number of males and females employed in each. This study should be indicative of the probable opportunities for future employment in certain occupations in Ponca City.

In order that the trade courses stay abreast of the times, and that students completing the trade courses have the information and training expected in the trades, the trade faculty has set up tentative courses of study and has invited men from the industries to a series of meetings to discuss and supplement these courses.

On January 12, the four members of the trade faculty met with the school superintendent, the junior-high principal, the superintendent of public school buildings, Mr. H. A. Huntington of the state department of trade and industrial education, a representative from the school of engineering at the Oklahoma Agricultural and Mechanical College at Stillwater, the junior-high-school trade faculty, three lumber men, two cabinetmakers, two hardware men, two furniture salesmen, a former lumber-mill employee, and an upholsterer, all from places of business in Ponca City, to discuss the proposed course of study for woodwork.

First an appeal for suggestions from those actively engaged in industry was made, based upon the fact that changes in available materials, new tools, new processes, and new avenues of service require ever-increasing knowledge and continual training. This appeal for suggestions and guidance from those actually in the various trades and occupations related to woodwork was based also upon the assumption that students will be more interested in and more anxious to comply with suggestions from those who are their probable future employers or associates, than they are for suggestions found in a text or expounded by a teacher whom they see daily.

Questions for consideration were such as these: What does a student need to know to become a cabinetmaker? an upholsterer? to sell furniture? to sell lumber? to sell hardware supplies? to become a salesman in a department store? to recognize quality of material in woods? to recognize quality of workmanship in woodwork? What should he be taught so that he will gain the desired knowledge and skill?

These questions were not answered separately and directly, but were kept in mind in discussing informally the separate items of the proposed possibilities for a course of study in woodwork. Each man present expressed his views openly on fields in which he was particularly interested or informed, and checked the items as requested on the proposed course of study sheets.

The following is a copy of this proposed course of study, plus the suggestions that were made:

Introduction

A survey of occupations in Ponca City has just been completed by the instructors of trade and industrial education of the junior and senior high schools under the supervision of Mr. Huntington of the Oklahoma A. and M. College at Stillwater.

The purpose of this survey is to determine:

1. The number of occupations represented in Ponca City.
2. The number of males and females employed in each occupation.
3. The type and kind of training and education necessary for employment in these occupations.
4. The possibility of training Ponca City boys and girls to fill such occupations.
5. The extent to which industry and education can co-operate for the benefit of both.

Woodworking and Related Trades

The purpose of the following sheets is an attempt to show what should be covered in the woodworking field. As we go through the outline it will be a "time saver" if the following system is used by all.

1. If a point mentioned is of little or no value, mark it "0."
2. If the point is of basic importance, mark it a number "1."
3. If the point is not of basic importance, yet of such consequence that the student should know about it, mark it with a number "2."

I. WHAT YOU SHOULD BE.

The following is a list of desirable attitudes and habits which will contribute to your success in life. Only *YOU* can develop them, and *you* should consciously practice them until they become fixed habits.

1. *Industry.* This means a habit of careful, thoughtful work, without loitering or wasting time.
2. *Co-operation.* This means an attitude of readiness to assist others when they need help, and to join in group undertakings.
3. *Consideration of Others.* This means a thoughtful attitude in the matter of making things easy and pleasant for others, such as keeping things in order, putting tools away in good condition, and always doing your full share of work where others are involved.
4. *Self-Reliance.* This attitude is a very important factor in success. It means that you should develop the habit of planning your tasks carefully and thoughtfully, and carrying them out with the least possible assistance. Be sure the problem is too difficult for you before you call for help.
5. *Readiness to Assume Responsibility.* This means that you should not refuse to undertake a task because it is difficult, and when once undertaken you should carry it through to completion.

II. THINGS YOU SHOULD BE ABLE TO DO WITH HAND TOOLS.

1. Measure and divide spaces with a rule.
2. Gauge with a pencil.
3. Gauge with a marking gauge.
4. Test for squareness with a try square.

5. Lay out square cuts with a try square.
6. Adjust a jack plane or a smooth plane.
7. Plane a surface true.
8. Plane an edge square with an adjoining surface.
9. Plane end grain.
10. Proceed properly in squaring up a board.
11. Saw to a line with a crosscut or ripsaw.
12. Use a backsaw.
13. Saw inside or outside curves with a coping saw.
14. Round edges with a plane.
15. Finish outside curves.
16. Finish inside curves.
17. Drill holes in wood.
18. Countersink holes.
19. Bore holes with an auger bit.
20. Fasten with screws.
21. Use brad awl for centering screws.
22. Trim or pare with a chisel.
23. Smooth a surface with sandpaper.
24. Shape ends, edges, and curves with a wood rasp.
25. Drive and draw nails.
26. Set a nail or brad.
27. Lay out and test bevel cuts with the sliding T bevel.
28. Round or form work with a spokeshave.
29. Lay out and cut a chamfer.
30. Use handscrews and clamps.
31. Make a butt joint.
32. Sharpen edge tools, such as knife, chisel, and plane.
33. Keep tools free from rust.
34. Adjust a block plane.
35. Use a gouge.
36. Smooth a surface with a scraper.
37. Glue up work.
38. Make a rabbet joint.
39. Make a half-lap joint.
40. Lay out and cut a dado joint.
41. Lay out and cut a cross-lap joint.
42. Make an edge to edge glue joint.
43. Lay out and cut tapers.
44. Dress a screw driver.
45. Set and use an expansive bit.
46. Put on locks.
47. Put on drawer pulls.
48. Fit hinges.
49. Put on ball catches.
50. Apply inlay.
51. Apply overlay.
52. Lay out and cut miter joint.
53. Make a dowel joint.
54. Use a doweling jig.
55. Make dowel pins.
56. Lay out and cut a blind mortise-and-tenon joint.
57. Lay out and cut a through mortise-and-tenon joint.
58. Lay out and cut a haunched mortise-and-tenon joint.
59. Construct a panel.
60. Make and fit a drawer.
61. Fasten on a table top.
62. Fasten with lag screws or bolts.
63. Sharpen a scraper.
64. Sharpen auger bits.
65. Sharpen a saw.
66. Use a Forstner bit.

III. THINGS YOU SHOULD BE ABLE TO DO WITH WOODWORKING MACHINES.

A. *The Jointer*

1. Put safety rules into practice.
2. Do the type of work on the machine that the machine is intended for.
3. Care for and adjust the machine.
4. Use push blocks whenever possible.
5. Joint an edge square.
6. Make a spring joint.
7. Surface thin stock.
8. Take the wind out of a board.
9. Cut tapers.
10. Plane end grain.
11. Cut a chamfer.

B. *The Circular Saw*

1. Put safety rules into practice.
2. Do the type of work on the machine that the machine is intended for.
3. Care for and adjust the saw.
4. Use push sticks when possible.
5. Rip.
6. Cut off.
7. Cut grooves.
8. Cut dadoes.
9. Cut tenons.
10. Cut miters.
11. Cut tapers.
12. Resaw.

C. *The Band Saw*

1. Put safety rules into practice.
2. Do the type of work on the machine that the machine is intended for.
3. Care for and adjust the saw.
4. Saw curves.
5. Rip.
6. Cut off.
7. Cut tenons.

D. *The Surfacer*

1. Put safety rules into practice.
2. Do the type of work on the machine that it is intended for.
3. Care for and adjust the surfacer.
4. Adjust for depth of cut.
5. Feed work into the machine.

E. *Disk Sander*

1. Put safety rules into practice.
2. Do the type of work on the machine that it is intended for.
3. Sand end grain.
4. Sand curves.

F. *Jig Saw*

1. Put safety rules into practice.
2. Do the type of work on the machine that it is intended for.
3. Care for and adjust the saw.
4. Saw curves.
5. Do pierced work.

G. *Mortiser*

1. Put safety rules into practice.
2. Do the type of work on the machine that it is intended for.
3. Adjust and care for mortiser.
4. Set and adjust chisels and bits.
5. Make setup for duplicate parts.

H. *The Shaper*

1. Put safety rules into practice.
2. Do the type of work on the machine that it is intended for.
3. Adjust and care for the shaper.
4. Set and adjust cutters.
5. Shaping with fence.
6. Free-hand with collars.
7. Shaping with templates.
8. Edge sanding on shaper.

J. *The Turning Lathe*

1. Safety rules for operating the lathe.
2. Range of work which may be done on the lathe.
3. Adjust and care for lathe.
4. Center stock.
5. Mount work between centers.
6. Rough down with a gouge.
7. Smooth with a skew.
8. Lay off pattern on piece.
9. Size with a sizing tool.
10. Mark off with a skew.
11. Use a cut-off tool.
12. Cut shoulders with a skew.
13. Cut tapers with a skew.
14. Cut beads or convex surfaces with a skew.
15. Scrape with a skew.
16. Scrape with a diamond point.
17. Measure with outside calipers.
18. Measure with inside calipers.
19. Cut concave curves with a gouge.
20. Make and use templates.
21. Mount work on a faceplate.
22. Mount work on a screw plate.
23. Size work on a faceplate.
24. Hollow out work on the faceplate.
25. Fasten pieces together temporarily for turning.
26. Cut off stock in a lathe.
27. Sandpaper in the lathe.
28. Apply finish in the lathe.
29. Make a hollow chuck and mount work on it.
30. Make a spindle chuck and mount work on it.
31. Make a setup for duplicate parts.
32. Make dowel pins on lathe.
33. Drill long holes through lamps.
34. Turn buttons or overlays on button jig.

IV. THINGS YOU SHOULD BE ABLE TO DO WITH FINISHING MATERIALS.

1. Apply stain.
2. Clean and care for stain brushes.
3. Apply stain for two-tone effect.
4. Apply filler.
5. Apply shellac.
6. Clean and care for shellac brushes.
7. Apply wax.
8. Apply enamel.
9. Apply paint with a brush.
10. Clean and care for paint brushes.
11. Apply varnish.
12. Clean and care for varnish brushes.
13. Apply lacquer.
14. Clean and care for lacquer brushes.
15. Apply finish with a spray gun.
16. Clean and care for spray gun.
17. Prepare wood surface for refinishing. (*a*) Remove old finish. (*b*) Restore surface.

V. THINGS YOU SHOULD BE ABLE TO DO WITH UPHOLSTERING MATERIALS.

1. Do upholstering involving simple padding.
2. Do upholstering involving webbing and rolled edges.
3. Do upholstering involving use of springs.
4. Prepare for reupholstering. (*a*) Remove old upholstering. (*b*) Restore padding for reupholstering.

VI. THINGS YOU SHOULD KNOW CONCERNING A PLAN OF PROCEDURE. IMPORTANT — KNOW SHOP RULES AND REGULATIONS.

1. Read a working drawing.
2. Make out a bill of material.
3. Plan a procedure for doing your particular job.

4. Check material when received.
5. Lay out pattern on stock.
6. Check the layout.
7. Lay out curves with dividers or compass.
8. Divide spaces with dividers.
9. Lay out an octagon.
10. Transfer a design.
11. Lay out irregular design by means of squares.
12. Lay out a hexagon.
13. Lay out duplicate parts.
14. Lay out an ellipse.

VII. THINGS YOU SHOULD KNOW CONCERNING FINISHING.

1. The object of finishes.
2. The kinds of finishes in common use, such as stain, oil, wax, shellac, varnish, lacquer, enamel, paint, and fuming.
3. The durability of different finishes.
4. The conditions or places in which various kinds of finishes may be used to advantage.
5. Materials from which finishes are made.

VIII. THINGS YOU SHOULD KNOW CONCERNING GLUE.

1. The kinds of glue.
2. The preparation of glue.
3. The conditions and requirements in use.

IX. THINGS YOU SHOULD KNOW CONCERNING THE MANUFACTURE OF WOOD PRODUCTS.

1. The location of important manufacturing concerns.
2. The division of labor in industry.
3. The use of automatic machinery.
4. Factory production methods.

X. THINGS YOU SHOULD KNOW CONCERNING LUMBER.

1. Identify the following kinds of lumber: pine, spruce, cypress, oak, walnut, birch, maple, fir, mahogany, red cedar, hickory, gum, chestnut, poplar.
2. You should know the principal characteristics, the working qualities, the principal uses, and the sources of supply of each.
3. You should know the methods of cutting and milling lumber.
4. How lumber is dried.
5. The effect of moisture on wood.
6. The standard dimensions of lumber and how classified.
7. You should know the nominal and the actual dimensions.
8. You should know how veneer and plywood are made, and used.
9. You should know the standard methods for grading lumber.
10. You should know many by-products of wood.
11. You should know method and extent of inspection of wood.

Following the discussion of what should be taught, the woodwork instructor arranged to get samples of by-products and new materials from some of the men present representing certain industries, and made a request for any available printed matter and a recommendation for the best books used in each field or industry.

The interest of those actively engaged in these industries in what is being taught to students who will become their future employees or associates was manifested in their response to the questions and the discussions, as well as in their response to the invitation to attend this meeting.

Courses of study for drafting, machinery, and electricity have been developed through similar group meetings at which the trade instructors presented their proposed courses of study to men actively engaged in these industries.

These discussions have led to a closer harmony and a greater interest between the school and the community, and a greater feeling of satisfaction on the part of the instructors who want to teach what is needed. Likewise on the part of the future employers and present taxpayers who expect training to be given for certain needs, and on the part of students who now realize that certain knowledges and skills are necessary, available, and worth while.

The Motor Club

R. W. Burgett

East High School,
Aurora, Illinois

Reducing the frightful toll taken yearly by the careless automobile drivers, presents a real challenge to every teacher of industrial arts and vocational education.

Automobile accidents in 1936 killed 11 per cent more boys and girls of high-school and college age than in the year 1935. As a matter of fact, statistics show that when a driver of this age becomes involved in an accident, the likelihood is that 60 per cent more of the accidents will result in a fatality than if the accident had occurred to a more mature driver. Of every 100 high-school students now 16 years of age (if the present accident rate holds), 12 will have been killed or permanently injured, the injuries causing such things as the loss of eyes or arms, or the fracturing of skulls; 65 will have been temporarily injured; and only 23 will not have suffered from automobile accidents before the end of their natural lives.

Startling figures show that the trend which had begun to develop in 1935 has continued, and today these figures are even more marked and horrible. American adults are gradually becoming reasonably safe drivers, but boys and girls are not. The propaganda for safe driving during the past several years has been concentrated on adults, and it is having quite a definite effect. But the new necessity for making "safety conscious" those who are just starting to drive, and for teaching them how to drive safely, has not been fully realized until quite recently.

It is only during the past year or two, that school boards, automobile associations, insurance companies, safety organizations, and other interested groups have started to give more than ordinary attention to the problem of making safe drivers out of the youth of today, and more especially out of the boys and girls of high-school age. These various groups realize that driving is not a natural activity like swimming to a duck. Driving an automobile must be *learned*. Nor should this learning to drive be left to trial-and-error methods; the errors are too dangerous for both the driver and for others.

Human Limitations

Nobody knows as well as one who drives, how dependent a machine can be upon the man who runs it. Certainly everything is being done that can be done to make motor cars operate as they should regardless of the drivers' skill. And still, cars cannot do a thing except under human direction. The automobile is a machine so much faster than man's "human machine" that he must learn, or reconsider his own limitations.

Even the self-starter, for example, deserves its name only in part. There must still be the foot to press the pedal, or the finger to touch the button or to turn the key. Power and speed in abundance are waiting in modern motors . . . but they await the command of a human driver. Steering is a direct and fairly simple thing, but it still depends on the pair of human hands on the steering wheel.

Most Will Drive

The need for *teaching* boys and girls how to drive safely would not be so urgent if most of them were not likely to become drivers. But most individuals now in the high schools of the United States will probably be using automobiles some time or another; many of them will be driving as an integral part of their daily lives, while

all of them will be pedestrians on automobile-infested streets and highways. If mere experience and such casual information as they may pick up are to be their only teachers, the consequences are likely to be costly in accidents both to themselves and to society at large. That is why industrial-arts teachers and others who are interested in stopping the appalling waste of human life through automobile accidents, should insist that instruction in the use of the automobile, *must* be made a regular part of the high-school curriculum.

The author believes that the safe driving program should be a school activity directed by the industrial-arts or vocational-education department of the school for the benefit of all students approaching the legal driving age. Resources of non-school organizations and individuals may often be secured for the development of such a program to supplement the school's resources in making the undertaking truly effective. Civic clubs are usually very interested in such a program, but the idea should arise from within the school.

Required Credit Course

In some states the state department of public instruction has assumed responsibility for the development of a safety consciousness among teachers in training and in service. In several states much has been done toward making a course in safe driving a required part of high-school work. Other state and city boards of education have given permission for such courses, while the following state departments have prepared outlines or other material to be used in them:

Colorado	Nebraska
Connecticut	New Hampshire
Delaware	New Jersey
District of Columbia	Ohio
Indiana	Pennsylvania
Iowa	Vermont
Massachusetts	Virginia
Michigan	West Virginia
Minnesota	

Numerous other bodies have worked out complete or partial courses in safe driving. The Automobile Manufacturers Association (New York City), the various insurance companies co-operating in the National Bureau of Casualty and Surety Underwriters (New York City), and several of the larger automobile companies have interested themselves in high-school instruction in safe driving, and have published some highly commendable pieces of research and course outlines.

The American Automobile Association (Washington, D. C.), the National Safety Council (Chicago, Ill.), the National Conference on Street and Highway Safety (Washington, D. C.), the American Council on Education (Washington, D. C.), the Office of Education of the Department of the Interior (Washington, D. C.), the Department of Commerce (Washington, D. C.), several of the leading universities, and other private or official organizations are making studies of the causes of automobile accidents, of methods of preventing them, and of ways to teach safe driving. Most of these organizations publish pamphlets which suggest material to stimulate interest in safe driving, or give specific suggestions for teaching it, or both. Several of the above also furnish very concise and excellent bibliographies of the material on the subject with the addresses of the individuals or organizations publishing the material.

Units of Instruction

Material especially designed for high-school courses in safe driving is no longer in the experimental stage, but has been tested and tried. For example, the National Safety Council, the American Automobile Association, and the National Bureau of Casualty and Surety Underwriters have all announced that they will be glad to co-operate in every way that they possibly can in helping high-school teachers develop or introduce driving courses.

Specific unit courses such as the following can be adopted and conducted according to local conveniences and desires:

Unit 1. The Causes of Accidents.
(How, when, and why they happen)
Unit 2. The Cost of Accidents.
(In lives, health, and property damage)
Unit 3. Courtesy of the Highway.
(Helpful, courteous factors not legally required of drivers)
Unit 4. The Motor Vehicle.
(Mechanical knowledge required for driving, selection, and care)
Unit 5. The Highway.
(Purposes, uses, safety features, history)
Unit 6. The Pedestrian.
(Responsibilities, attitudes, etc.)
Unit 7. The Driver.
(Physical makeup, responsibilities to other drivers, to society, to pedestrians, etc.)
Unit 8. Traffic Regulations.
(Official state code)
Unit 9. Highway Patrol Officers.
(Efforts made by state to reduce hazards)
Unit 10. Co-operative Safety Agencies.
(The A.A.A and affiliated clubs, National Safety Council, State Divisions of Highways, etc.)

School Motor Clubs

As the name indicates, the school motor club is an extracurricular activity made available for those students having a mutual interest in automobiles and automotive safety. The objective of this club is to give students an added opportunity to engage in outside interests and experiments in automotive safety, for which the usual class hour does not allow time. The faculty adviser of the club must furnish instruction in skills, habits, procedures, and controls which constitute the safe handling of an automobile. He has a live medium for stressing personality development with an aim to modify the social motivation of the students. Here, the students may further learn the desirable attitudes and ethical attributes which characterize the "good driver." They can acquire safe driving habits which will dominate their traffic behavior. In the motor club, as in the classroom, a student is made to realize that traffic laws and regulations are not arbitrary, but represent a code of social behavior based on an analysis of highway needs, upon which a majority opinion has been formed.

The motor club is an organization to which every member of an automotive safety class may automatically belong. The club can provide a wide variety of challenging activities which represent different types of learning experiences, such as those of a problem-solving nature, creative expression, practical application, and group co-operation. For example, this year the author's East High School Motor Club has enjoyed such activities as sponsoring a driver-testing clinic for 600 upperclassmen, driving demonstrations, discussion meetings with safety leaders and traffic officials, compiling scientific recommendations of suggested local traffic changes and improvements, and the publication of a Student-Drivers' Handbook for all high-school students.

Driver-Testing Equipment

The American Automobile Association and also other affiliated motor clubs have recently announced that driver-testing equipment is available for demonstrations throughout the nation in territories serviced by these organizations. The testing apparatus is available over a coast-to-coast itinerary, and dates for convenient showings can be secured. Most American cities have motor clubs affiliated with the A.A.A., through which this co-operation is assured. This nation-wide project is made possible by grants from the automotive industries.

These complete sets of testing apparatus afford an analysis of fitness and aptitude for automotive driving. Through these devices fundamental capabilities or skills involved in driving are checked and studied. The tests do not definitely prove that one actually is or is not a good driver, but indicate potential ability to drive properly. They have been used with a large number

of drivers and hence the readings can be quite safely interpreted.

The series of tests includes: a drivometer test, excitability test, selective reaction time, rapid activity, motor coordination, speed estimation, strength of grip, blood pressure, eye dominance, glare resistance, perimeter of vision, acuity of vision, test for phorias, distance judgment, stereoscopic tests, color perception, hearing, and other minor tests.

The value of having high-school drivers take these tests is that physiological defects that can be corrected are disclosed. Other weaknesses not correctible and of which the driver is often entirely unaware, are also found. Knowing of them, one will be able to make the necessary allowances in driving. Sponsoring and giving of these tests provide an excellent medium for a high-school motor club to do something truly constructive in traffic safety education. Then too, the knowledge and experience gained through conducting the tests will aid in the eventual standardization of compulsory driver-testing devices and procedure all over the country.

Certificate of Completion

The satisfactory completion of a course in safe driving may well require the award of a "Certificate of Completion." Such a certificate may be made very desirable and attractive, and may be presented in such a way that each student is justly proud of his accomplishment.

It is the author's belief that every local police department will be glad to furnish such documents and will also be happy to assist in their presentation. The following is an example of what can be done by an agreement between an interested police department and a safety instructor:

Upon the reverse side of the certificate is the *safety pledge* which the student signs. In the author's classes, this pledge is administered by the chief of police. The administering of the pledge is made as impressive as possible. Students about to receive the certificate are asked to stand beside their seats and raise their right hands in pledge, repeating the pledge after the chief of police.

Safety Pledge

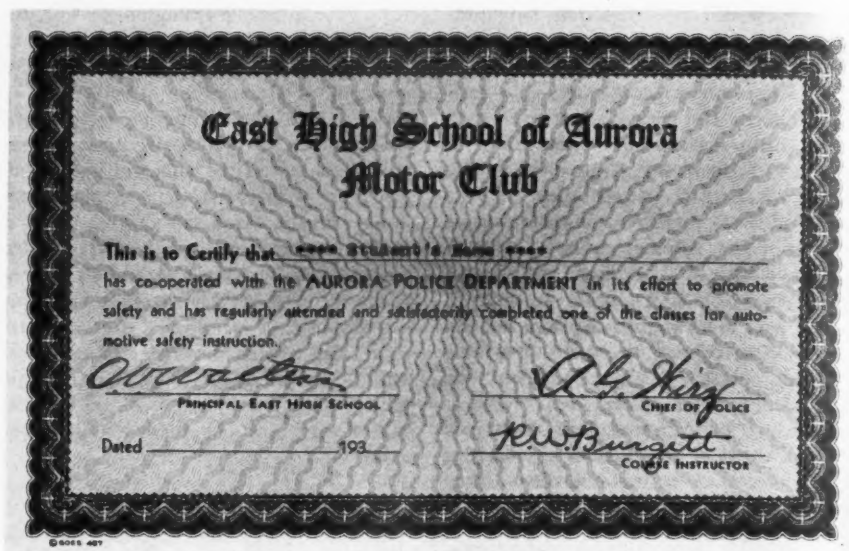
I pledge myself:

1. To drive with extreme care at all times.
2. To exercise unusual care in approaching groups of children at play.
3. To keep my car in good mechanical condition, with special attention to brakes.
4. To see that my lights comply with the law and are in good working condition, and that the windshield is always clean to minimize dangers of night driving.
5. To signal following drivers when I intend to turn or stop.
6. To study and obey all traffic laws.
7. To avoid carelessness so that sacrifice of human life and unnecessary suffering may be stopped — and the streets of AURORA made safe.

Student's Signature .....

After the foregoing pledge has thus been administered, the students are asked to be seated and sign their names to their pledges. It is indeed astounding to note the pride that each student has in his or her certificate, and its attainment has proved to be a genuine incentive.

Each certificate is signed by the local chief of police, the high-school principal, and the instructor. This pledge is kept "active" by a record in a card index file in the police department containing the names of all recipients of such certificates.


East High School of Aurora
Motor Club

This is to Certify that **** Student's Name ****
has co-operated with the AURORA POLICE DEPARTMENT in its effort to promote safety and has regularly attended and satisfactorily completed one of the classes for automotive safety instruction.

PRINCIPAL EAST HIGH SCHOOL — CHIEF OF POLICE

Dated _____ 193_ — COURSE INSTRUCTOR

Certificate given to students at end of safety course

The Challenge

If a course in safe driving is already being given in your school it is your duty as an industrial teacher to find out whether the large volume of available material is being used to the fullest extent. If there is no such course, your first step is to see what your local and state school authorities have done about this "new necessity" and what interest there is among them. From there, you can go on to prepare a course directly, if there is enough interest, or indirectly, if you have to create interest among fellow teachers, students, and parents. Any of the organizations which have been mentioned in this article are willing to help you, if YOU will but do your share in meeting this "new necessity" which challenges our whole profession today.

Casting in the School Shop — X

N. A. McMillan
Elmira, New York

For previous articles in this series, see January and September, 1934; May and October, 1935; April, September, and December, 1936; and March and September, 1937, issues of this magazine.

Copper Alloys

Copper and its alloys will be treated somewhat in detail because this information finds many uses if it is properly understood. The projects made from copper-base metals are usually lasting and beautiful.

There are two outstanding alloys of copper, namely, brass and bronze.

Brasses. A yellow brass containing 70 per cent copper, 27 per cent zinc, 2 per cent lead, and 1 per cent tin is a typical yellow brass. The tin hardens the brass and the lead makes it machine more readily. Brass is soft enough so that it can be machined with little difficulty. The yellow brass mentioned is very good for school use on candlesticks or any ornamental project for the house.

Table I shows the different types of brasses used.

Table I

	Copper	Tin	Zinc	Lead
Naval brass	62	1	37	
Brass bearing	87.7	11	1.3	
Tough brass for engines	76.5	11.8	11.7	
Red brass	87	4.4	4.3	4.3
Yellow brass	70	1	27	2
English brass, A.D. 1504	64	3	29.5	3.5

Bronze is an alloy of copper and tin which usually is deoxidized by a third constituent.

Art bronze (dull-red fracture) is the best for school purposes. It consists of 97 per cent copper, 2 per cent tin and 1 per cent zinc. There are many mixtures for bronze which are listed in Table II.

Table II

	Copper	Tin	Zinc	Lead
Bronze, pieces subject to shock	83	15	1.5	.5
Phosphor bronze, for valves, pumps, and general work	92	8 (phos.)		
Art bronze, dull-red fracture	97	2	1	
Gold bronze	89.5	2.1	5.6	2.8

Aluminum bronze, 85 to 89 per cent copper, 1 to 3 per cent iron, 8 to 10 per cent aluminum.

Melting Copper and Copper Alloys

Copper as a pure metal is very seldom cast, especially for use in the school shop.

The order of charging the constituent metals of a bronze into the furnace is of some importance. The copper should be melted first and it should be protected by a layer of charcoal or coke breeze while melting. As the copper in the crucible melts down, more is added, as rapidly as possible. Copper is a metal that does not corrode or oxidize readily at atmospheric temperatures, but as it approaches its melting point, it oxidizes very readily. Melted copper, when handled in the air, will absorb enough oxygen to become useless.

When melting copper for copper castings, therefore, a *deoxidizer* of 15 per cent silicon copper or boron copper is put in and stirred well just after the crucible has been removed from the furnace. Care should be taken not to heat the metal hotter than is consistent with handling and pouring. Just before pouring, the charcoal must be skimmed off, and then the copper should be rapidly poured into the mold.

When copper is melted for making tin and lead alloys, melt the copper first and then add the lead and tin. The crucible is removed from the furnace, the deoxidizer of phosphor copper is added, the metal stirred, well skimmed, and poured. In adding the phosphor copper, if only deoxidizing is desired, 6 to 8 oz. per 100 lb. of metal are sufficient. If phosphor bronze is desired, add up to 1 lb. of phosphor copper per 100 lb. of metal, depending upon the hardness desired. It is good practice to put 3 oz. of the phosphor copper per 100 lb. of metal in the crucible before the metal is charged. If the charcoal cover works perfectly, this will not be necessary, but better results are obtained by preventing oxidation rather than by deoxidation.

In melting copper for brass, the same methods are used as for making bronze.

Prolonged stewing of the bronze or brass after adding alloyed metals must be avoided.

Scrap Metal provided its composition is accurately known, may be used freely. There have been discussions at times as to the desirability of casting bronze made entirely from virgin metals, and it has been said that new metals should always first be poured into ingots and remelted before casting. On the other hand, there are foundries which do not use ingots and scrap metals, except for unimportant work, and insist on virgin metal whenever exceptionally good castings are required.

Casting Temperature. After melting, bronze must be superheated to well above its pouring temperatures, so that there is ample time to transport the metal to the molding unit and to measure its actual temperature. When the ladle of metal is in position for casting, the bronze may be either allowed to cool naturally or small pieces of scrap metal may be added to bring it down to the predetermined casting temperature. Casting temperature is usually understood to mean the temperature of the molten metal in the ladle when pouring is started.

The density of bronze very closely follows the hardness values, that is, the density increases as the casting temperature falls (see Figure 1).

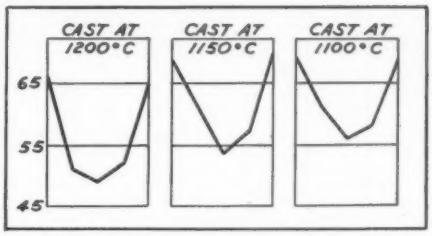


Fig. 1. Variation in hardness with casting temperatures

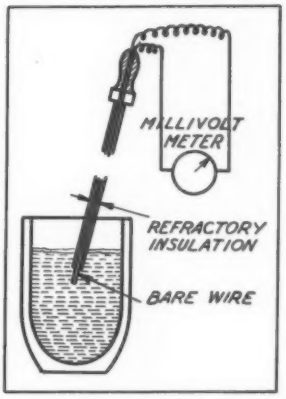


Fig. 2. Pyrometer for measuring temperatures of molten metals

Measuring Metal Temperatures

To ascertain the temperatures of molten metal, a good pyrometer is essential unless one has had long experience in judging the colors of metal when it reaches the casting temperatures. The only safe way is to measure the temperatures by a pyrometer as shown in Figure 2.

It is necessary to insulate wires from the surface of the molten metal, and for this purpose it is most convenient to wrap the wires with asbestos string, and then to smear a thick coating of refractory cement, which should be of such a composition that it will dry without cracking and be mechanically hard and strong. About 2 inches of the wire should be left bare for the hot junction, but the bare ends need not be twisted together as is usual in thermo couples. The adherent metal and slag should be cleaned off the bare ends after each immersion, and as the ends corrode away, a new portion should be cleared of the insulation. The wires which have been most successfully used in recent years consist of patented alloys sold under the names of Chromel-Alumel and other names.

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Story of Copper, Watson Davis.

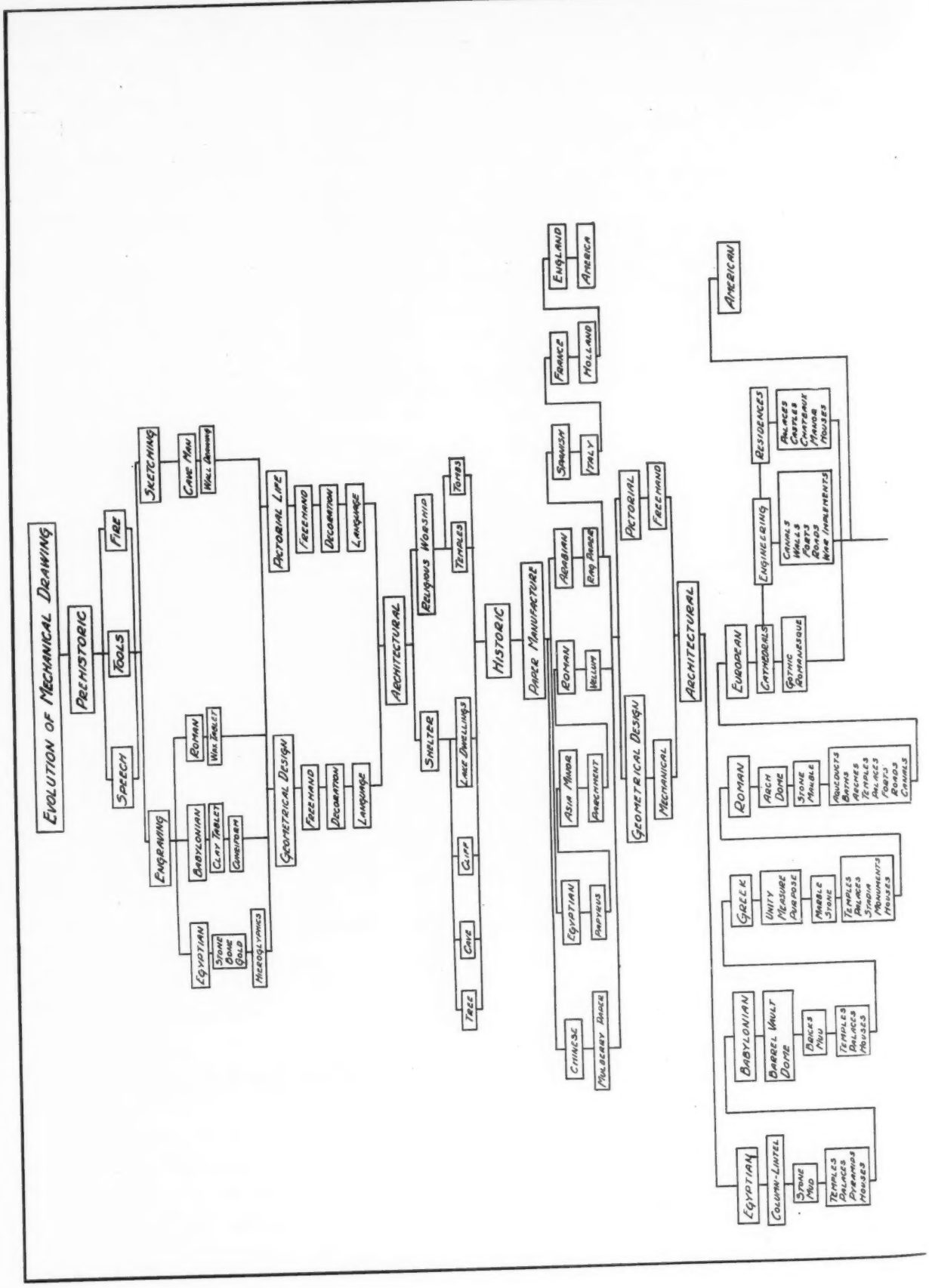
Evolution of Mechanical Drawing

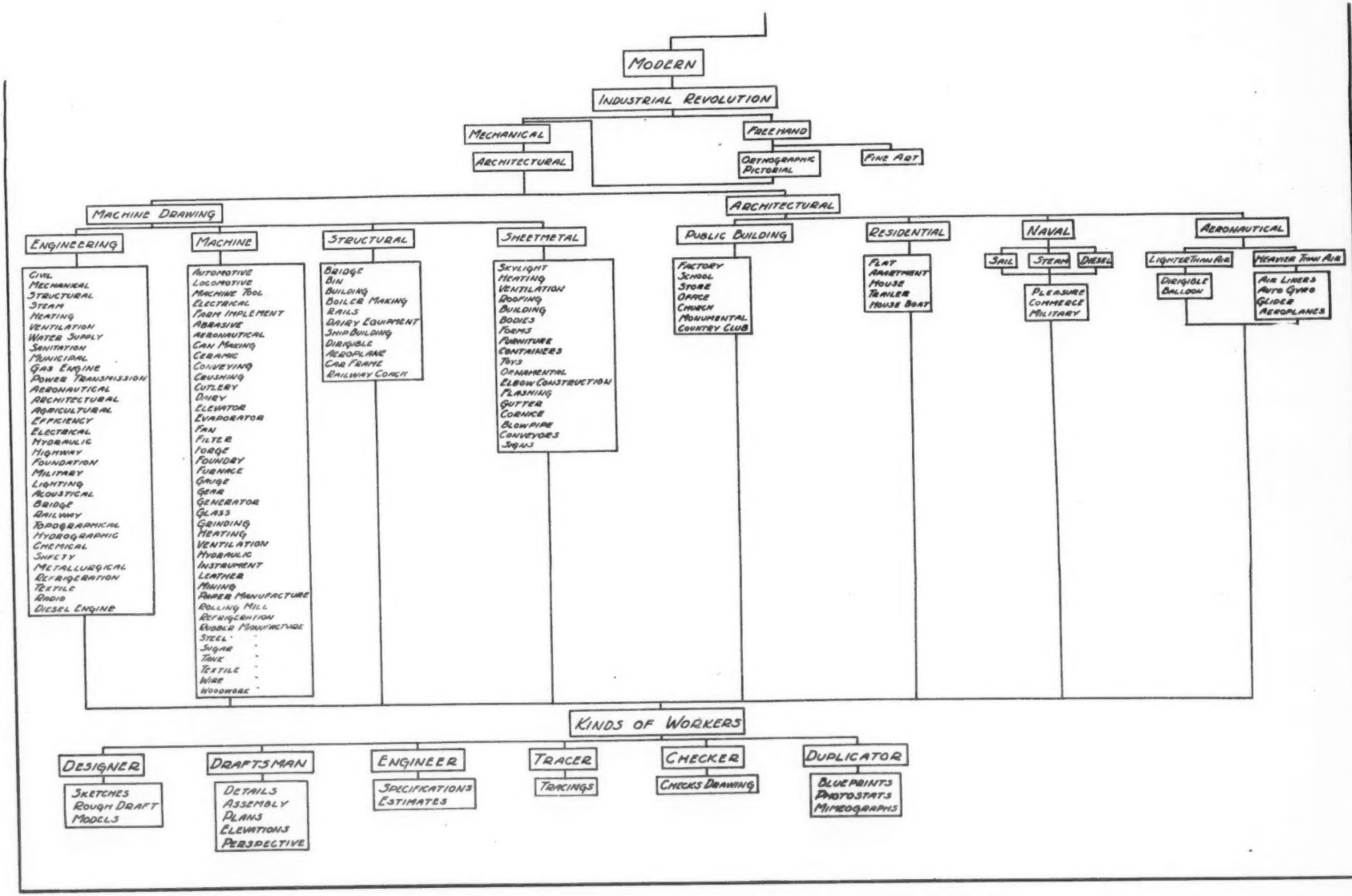
Harvey W. Waffle

Waukesha, Wisconsin

A brief historical sketch of the origin and development of mechanical drawing and of its relationship to modern engineering.

The origin of drawing is lost in the mists of those prehistoric ages on the banks of the Nile, which research of modern Egyptologists has pushed back apparently to the distance of 80 centuries. From dependable records, we have learned of the sources and kinds of materials used, methods of construction, and the marvelous skill exhibited in the construction of


EVOLUTION OF MECHANICAL DRAWING
PREHISTORIC
SPEECH
TOOLS
FIRE
SKETCHING
CAVE MAN
WALL DRAWING
ENGRAVING
BABYLONIAN
CLAY TABLET
CUNEIFORM
ROMAN
WAX TABLET
EGYPTIAN
STONE
BONE
GOLD
HIEROGLYPHICS
GEOMETRICAL DESIGN
FREEHAND
DECORATION
LANGUAGE
PICTORIAL LIFE
FREEHAND
DECORATION
LANGUAGE
ARCHITECTURAL
SHELTER
TREE
CAVE
CLIFF
LAKE DWELLINGS
RELIGIOUS WORSHIP
TEMPLES
TOMBS
HISTORIC
DARK MANUFACTURE
CHINESE
MULBERRY BARK
EGYPTIAN
PAPYRUS
ASIA MINOR
PARCHMENT
ROMAN
VELLUM
ARABIAN
RAG PAPER
SPANISH
ITALY
FRANCE
HOLLAND
ENGLAND
AMERICA
GEOMETRICAL DESIGN
MECHANICAL
PICTORIAL
FREEHAND
ARCHITECTURAL
EGYPTIAN
COLUMN-LINTEL
STONE MUD
TEMPLES PALACES PYRAMIDS HOUSES
BABYLONIAN
BARREL VAULT DOME
BRICKS MUD
TEMPLES PALACES HOUSES
GREEK
UNITY MEASURE PURPOSE
MARBLE STONE
TEMPLES PALACES STADIA MONUMENTS HOUSES
ROMAN
ARCH DOME
STONE MARBLE
AQUEDUCTS BATHS ARCHES TEMPLES PALACES FORUM ROADS CANALS
EUROPEAN
CATHEDRALS
GOTHIC ROMANESQUE
ENGINEERING
CANALS WALLS PORTS ROADS WAR IMPLEMENTS
RESIDENCES
PALACES CASTLES CHATEAUX MANOR HOUSES
AMERICAN



The Evolution of Mechanical Drawing. Diagram by Harvey W. Waffle, Waukesha, Wis.

such wonders as the pyramids of Egypt, the Parthenon of Athens, and the viaducts of Rome. Though there is a wealth of available information relative to the early structural accomplishments, there seems to be a missing link between the design and execution of the ancient works. At the present time, the construction of even simple buildings or machines is always preceded by designs executed in the form of mechanical drawings. Such a practice it seems, also must have been essential in ancient and medieval times, though we have very little evidence to that effect.

Drawing of the Ancients

Drawing in those early days, was a strictly conventional and symbolic art, devoted to the service of the monarch and of religion. Sculpture was subservient to architecture and painting, except on the walls of tombs and in the papyri. The conventions in which the art of drawing remained bound were established in the earliest ages. For landscape and architecture, there was adopted an ingenious combination of drawing, both in ground plan and in the elevation, to express the idea in the simplest and clearest manner possible. Probably the most concrete of these indications is among the Chaldean statues. On the knees of one image lies a tablet intended to receive an inscription or design. Another similar statue, of smaller proportions, holds on its knees the same kind of tablet on which the plan of a fortress, with its bastions and posterns, is engraved in outline just as an architect of the present day would draw it. A graduated rule, subdivided into fractions of unequal but proportional length is carved in relief beside the plan for which it serves as a scale. Finally, at the side lies the stylus with which the architect engraved his design.

Vitruvius, a famous Roman architect who lived in the first century B.C., wrote ten books on architecture from which we can find suggestions of the use of mechanical drawing. He refers to the drawing of a plan and elevation in a very matter-of-fact manner, but no record of a plan has reached us.

Some books describe the trestle board as an elevated tablet at which a man could stand and engrave in stone a working drawing to which the builders referred until a certain unit was finished, after which the architect provided a tablet with a drawing of the next unit.

With the gradual break-up of the Roman Empire, most of the secrets of an older art were lost. The Romanesque buildings show little trace of the architect's skill or art. Vigorous and picturesque as many of them were, they were such as could have been built by masons under the general instructions of an accomplished builder. Such apparently continued to be the practice of building until well into the middle ages. We have certain drawings of the Cathedrals of Siena and Cologne, and there were elevations of the west front of the Cathedral of Orvito supposed to have been made soon after A.D. 1310. These drawings are not really working drawings, inasmuch as they are set in slight perspective which, though not correct, is near enough to make one doubt whether they can be as early as A.D. 1310.

As early as the fifteenth century, when the chapel of Henry VII was built, it is not likely that the architect worked at a drawing board. His part was to organize and administer, and to decide on the general purpose and character of his building. The workman, with an immortal tradition behind him, would have no difficulty in interpreting directions so given, and though he might modify his detail here and there, and perhaps introduce some fancy of his own, he would not conceive of the possibility of serious deviation from a well-planned course. In modern architecture and drafting, this procedure has been reversed. The change dates from the early days of the Renaissance, at which time new orders or styles were introduced. The tradesmen were not familiar with the new styles, thus it was necessary that everything be explained down to the minutest detail. Though it would not be practical today, the old system of building had its merits in that the architect was always on the job where he could test and alter his program as the work went on.

Drawing During the Renaissance

Although primitive attempts to express ideas graphically must have been made in the earliest ages of man, the scientific delineation of objects, and especially the development of the graphic language, is of comparatively recent growth. The delineation of the human figure and that of animals is found in the records of the most ancient civilization, but it was in outline only and with no suggestion of rounded form. The early landscape drawings expressed but slight suggestions of depth or distance, and it was not until the period of the Renaissance, which was about the time of the discovery of America, that any understanding of the theory was made known. Although the early Greek mathematicians had investigated the mathematical principles of perspective, the graphic application of the theory was not made until the fifteenth century.

Leonardo da Vinci (1452–1519) was one of the great artists of that period, and a greater scientist and engineer, wrote a treatise on painting which included a thorough development of the theory of perspective in sufficiently good form and detail to be used at the present day as a text on that subject. The principles of the new science were rapidly adopted and applied to the paintings of that day by Michael Angelo, Raphael, and other great artists of the period who introduced many architectural details and landscapes into their masterpieces with apparent pride in displaying the newly found principles.

Nothing has yet been mentioned in regard to machine drafting. The reason is that until modern times, the few machines in use were of simple design, and these were usually made by the tradesmen who planned them. The mechanical devices which were introduced through the arts of war and engineering, were largely described in a pictorial manner, whenever more than a written description was necessary. During this period, no technical difficulties were encountered in the rendering or reading of drawings. Not until the development of steam gave rise to the production of power, independent of wind and water, did drawing begin to grow and the expression of thought through lines assume the dignity of a language. But with the development of mechanisms, the inaccuracies due to the crude methods of pictorial representation led to confusion and increased expense in construction, thus necessitating the development of a graphic language. In the early part of the nineteenth century, the demand for increased facilities in transportation and manufacture stimulated inventive genius and introduced the age of engineering which has characterized the last century.

Orthographic Projection

Orthographic projection, which is the basis for all machine drawing, was first developed by Gaspard Monge, a noted French mathematician and physicist, and a treatise on it published by him in 1795. During the first half of the following century, drafting became an art. Draftsmen seemed to have devoted themselves to the task of making fine drawings for the sake of drawing itself. The fact that the early machine draftsmen were taken from the field of architecture may account to some extent for the fancy style of drawing. Because of the lack of reproduction methods at that time, original drawings were worn out by use, so that few have reached us. We know, however, that although they were ornate, they were also very accurate, and that objects were well represented.

During the last half of the nineteenth century came wonderful industrial improvement, which brought with it increased demand for draftsmen and the necessity for specialization. Modern drafting really came into being about 1880, at which time the blueprint process was perfected to a point

where the reproduction of drawings became practical. High-speed industrial demands have changed machine drawings from the ornate stage to that of maximum simplicity.

Ancient Engineering

Engineering is not a product of our present age, even though it has made use of the great discoveries of modern times. It is, in fact, one of the most ancient of arts, and had been brought to a remarkable state of perfection among Eastern nations centuries before the birth of Christ. The irrigation dams and canals that watered the valleys of the Nile and the Euphrates about 2000 B.C. are among the earliest engineering feats known. There is good reason to believe that a small ship canal was constructed between the Red Sea and the lower Nile 20 centuries before the construction of the Suez Canal. One of the greatest engineering feats of all time was the building of the mighty pyramids of Egypt. So perfectly were they planned and executed that the most delicate of modern engineering instruments and calculations fail to find an error in the theory or practice of their construction. Such temples as those of Karnak, Edfu, and Luxor, in the valley of the Nile, manifest by the size of their columns and pylons the problems that faced the architect-engineer in Egypt. The Egyptian engineers seem to have confined their endeavors to the fields of hydraulics and building construction.

Although the Greeks are known to have developed theoretical engineering principles, they seem content to have remained theorists and allowed the Romans to utilize their knowledge. Many of the greatest Roman engineering feats were supervised by Greek engineers. The Romans left behind them striking monuments to their engineering skill in bridges, arches, aqueducts, and roads which they built, and in such structures as the Colosseum at Rome. The Romans had only crude tools for highway construction; they understood simple surveying and used instruments called the *groma* and *chorobates* for running levels and making alignments. They tested their foundations to determine the nature of the subsoil and the depth to a firm foundation.

The Middle Ages saw the rise of a new form of engineering in the building of the great cathedrals of Europe. They were a result of a union in engineering and art, and to the artist. or architect, belongs the credit for spurring the engineer on to new achievements in order that art might be served. The transportation engineer also came upon the scene in those days, and the wheeled vehicle ascended from its primitive beginning to the point where it became ready for the age of power.

Modern Engineering

The Industrial Revolution ushered in the age of power, and out of this grew what we know today as the *Machine Age*. So wide are the applications of power today that engineering has become a profession of highly specialized pursuits. When we mention such diverse branches as railway engineering, mechanical engineering, electrical engineering, civil engineering, and mining engineering, we have only begun to recite a long and ever growing list of headings and subheadings under which the engineer today can be classed.

Roads and bridges, water supply, drainage canals, harbors, tunnels and buildings are all branches of civil engineering. The modern civil engineer makes the preliminary surveys and prepares maps, specifications, contracts, estimates of cost, and reports for a wide variety of projects. He also prepares detailed drawings, inspects and superintends construction, and in many cases operates the products of his work. The civil engineer must decide whether his talents will be employed as highway, railway, municipal, hydraulic, sanitary, structural, or bridge engineering, or in city planning, surveying, or geodesy. Indeed, even these divisions may be broken down further to indicate the ramifications of engineering today.

Utilization of electric power for transportation has opened up an entirely new field of engineering. Communication by telephone, telegraph, radio, television, and wirephoto; electrical illumination in all its forms; electrical equipment such as dynamos, motors, and electron tubes; household and office appliances operated by electricity — all of these require the constant attention of electrical engineers and new fields of applied knowledge of electricity are opened almost daily. Here again some engineers prefer to follow the occupation of designers and express their thoughts by drawing up plans and specifications for the manufacture and installation of electrical equipment. Others are busy with research in finding new devices and new applications of old materials. Still others carry out investigations for the development of ideas which suggest themselves as worthy of exploitation.

The mechanical engineer is the power engineer. Whether the power is derived from burning coal under a boiler, from the force of falling water, from the gasoline or Diesel engine, or even directly from the sun itself, it is the mechanical engineer who leads the way to better utilization of fuel resources. He must constantly design and operate better engines with a view to obtaining the maximum output of useful work from a minimum input of fuel. Although the mechanical engineer can trace his own history back to Empedocles and Archimedes who invented the screw and steam turbine and discovered the use of the level, or to the hero of Alexandria, who in 200 B.C. invented a reacting turbine, and to the primitive methods of using the power of falling water for grinding corn. It was the perfection of the steam engine by James Watt in 1774 that witnessed the rise of the profession. Mechanical refrigeration owes its development to mechanical engineering as do also heating, ventilating, air conditioning, locomotives, airplanes, ships, compressed-air machines, and automatic machinery of many kinds.

Chemical engineering is the art of manufacturing useful products through the application and control of chemical processes. Plastics, rubber, textiles, petroleum, metallurgy, cosmetics, brewing, distilling, tanning, ink manufacture, photographs, papermaking, paints, dyes, explosives — these and a hundred others require the services of thousands of chemical engineers.

Mining engineering includes the art of locating ores and other mineral products and extracting them from the earth. It includes also the geology, mineralogy, chemistry, and the processes of preparing for and transporting to market ores, petroleum, ceramic products, coal, and coke.

Military engineers are specialists of tactics and maneuvers, coupled with the ability to overcome natural obstacles in the way of an advancing army. Their knowledge is augmented by special army or navy training.

Marine engineering is partly military and partly civil, embracing naval architecture, building and operation of ships and naval accessories.

Sanitary engineering consists of the construction of sewers and drains, providing for the cleaning of city streets and the disposal of garbage and sewage, reclaiming of swamps, and overcoming of all conditions tending to interfere with public health.

To these groups may be added such types of engineering as administrative engineering, general engineering, engineering administration, aeronautical engineering, automotive engineering, bridge engineering, ceramic engineering, electrochemical engineering, marine engineering, and naval architecture.

All of the engineers are dependent upon mechanical drawing and the modern draftsman for the wonderful progress they have made and are making.

THE FUNDAMENTALS

It is a peculiar twist, to my academic way of thinking, that makes reading, writing, and arithmetic fundamental. They are not. The fundamental things are homemaking, and industry, and the fine arts.

— George D. Strayer

A Desk Set in Copper—II

Leon H. Baxter

Pawling School,
Pawling, New York

The second of a series on an interesting art-metal project.

Desk Calendar

First, measure a 3- by 6-in. piece of 18-gauge copper. Then lay out the outline of the stand as shown on Plate 2, on a piece of paper. This is then glued to the piece of copper. Saw to the line, finishing with file and No. 0 emery cloth. Round off all corners with a file as shown in Plate 2. Next planish or hammer with the ball-peen hammer, all of one surface as far as line *X*. Turn the metal over and hammer the opposite side from line *X* for the base. This is so that all exposed surfaces will have a planished finish. Hammering copper or brass hardens it and before bending on line *X* to the required angle the piece of copper must be annealed or softened by heat. This is done by playing the blow torch on the metal until the colors follow the flame about on the metal. Cool the metal under water and flatten out by using either rawhide or a fiber mallet. The piece is now ready to bend. Take two pieces of straight-edged hard wood, 4 or 5 in., and place the metal between them so that line *X* is parallel to their edges. See Figure 11, page 285, September, 1937, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION. Place in the vise and bend to desired angle by striking with a fiber mallet. This prevents marring the surface. Place on a level surface and hammer with a fiber mallet until both the front and base are perfectly flat and the whole piece sets level.

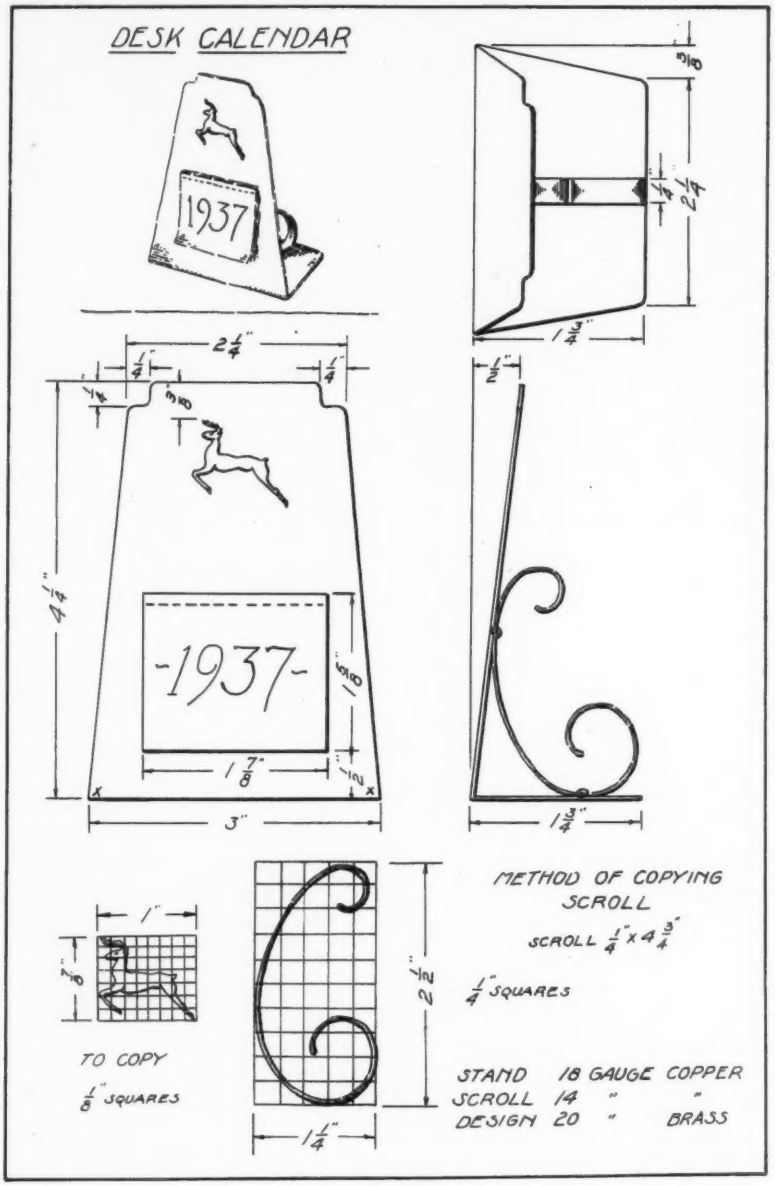


Plate 2. The desk calendar

From a piece of 14-gauge copper, cut a strip ¼ by 4¾ in. for the scroll. Planish this on both sides and anneal.

Copy the outline of the scroll full size on a piece of heavy paper. Bend the metal to the shape desired around some cylindrical pieces of metal, using the layout for checking. Odd sizes of pipe are fine for bending scrolls, the pipe being held in a vise and the metal bent by hammering with a mallet.

Place in the position shown in the side view on Plate 2, and locate the points of contact. At these points, holes must be carefully centered and drilled to receive copper rivets. Mark the position of the holes also on the front and bottom of the calendar stand, halfway between the sides, and drill the holes. Try the rivets and cut them off at a length that allows them to project through both pieces of material a scant 1/16 in. If a rivet setter is not available, place the head of the rivet on some metal surface, and with a small riveting hammer set the ends flush with the surface. If these are carefully hammered, they will hardly show. See Figure 16, page 286, September, 1937, issue of this magazine.

Copy the deer design by the square method and saw, file and finish with emery cloth to a smooth surface.

Follow the method described under "Soft Soldering" and "Finishing," and complete the calendar stand (see page 283, September, 1937, issue of this magazine).

A small calendar of the size indicated may be bought at the dime store for a penny and glued to the front surface as shown.

(To be continued)

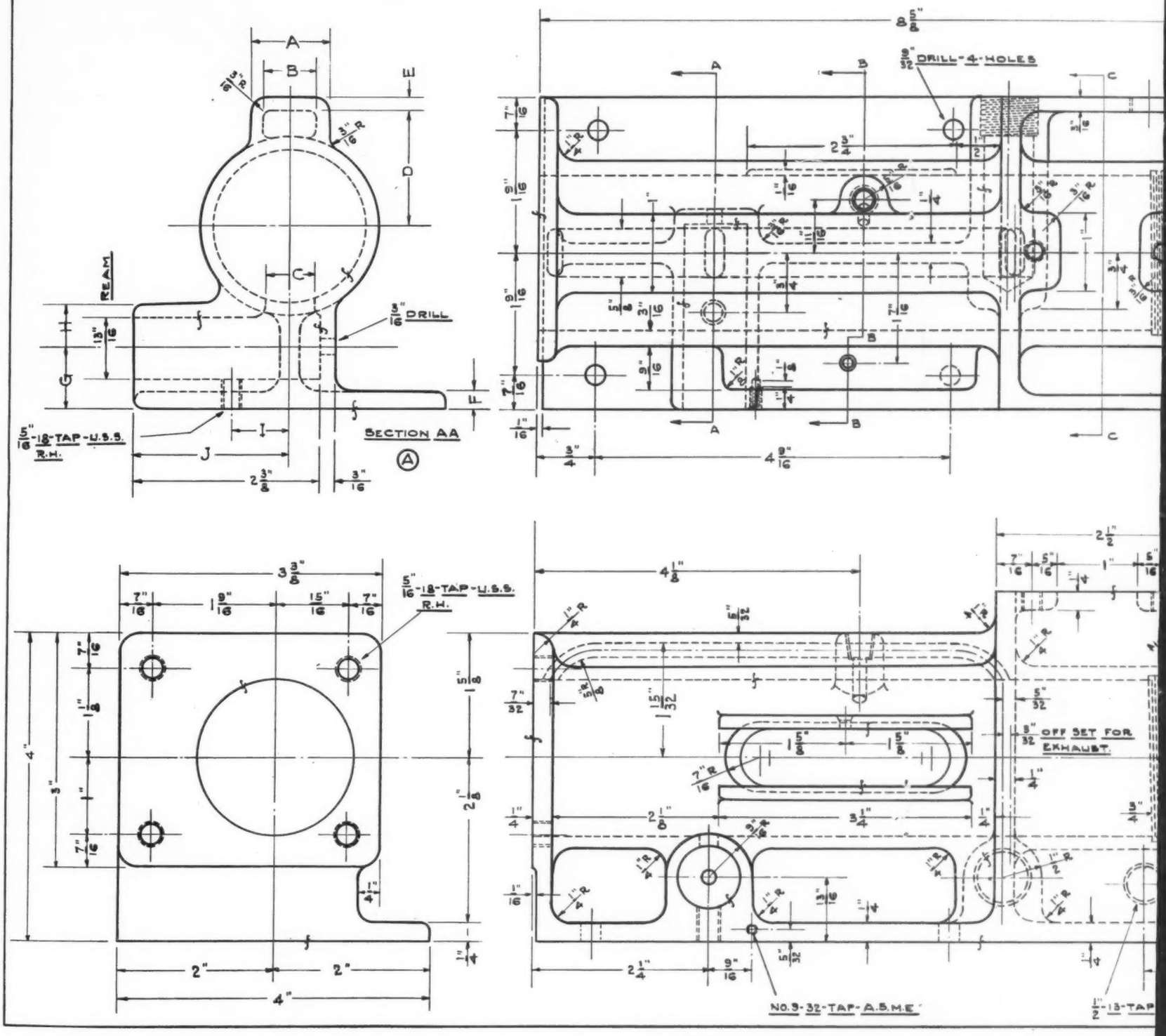
CONSUMER VALUES IN INDUSTRIAL ARTS

Industrial arts is a study of great importance for developing efficiency in selection, use, and care of industrial products.

—O. E. Sink

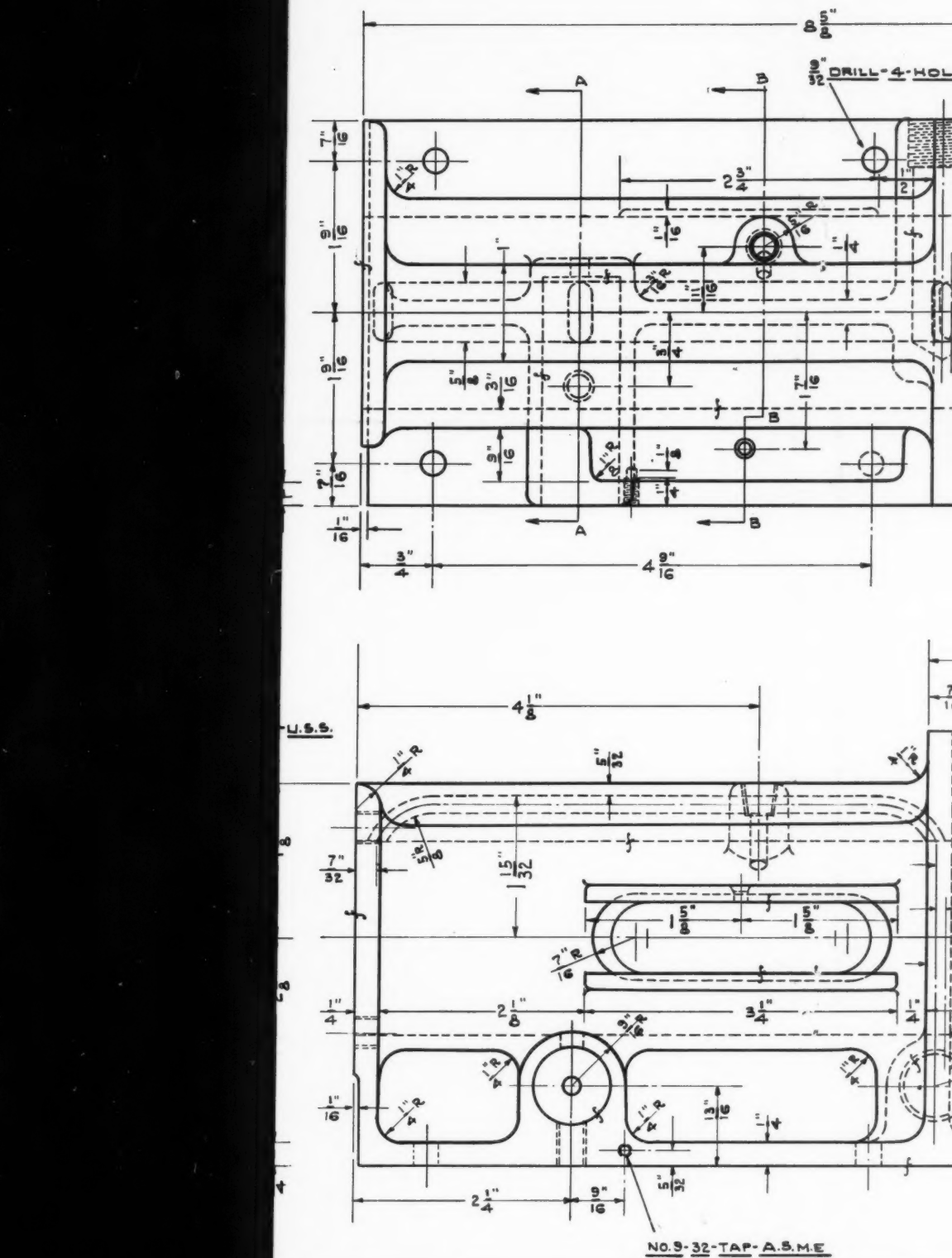
JOB NO.

FIND THE MISSING DIMENSIONS FROM A TO Z ON THE DRAWING OF THE GAS ENGINE CYLINDER AND LIST THEM
SHOW VIEW (A) IN CROSS SECTION. SHOW VIEW (B) IN CROSS SECTION. SHOW VIEW (C) IN CROSS SECTION.



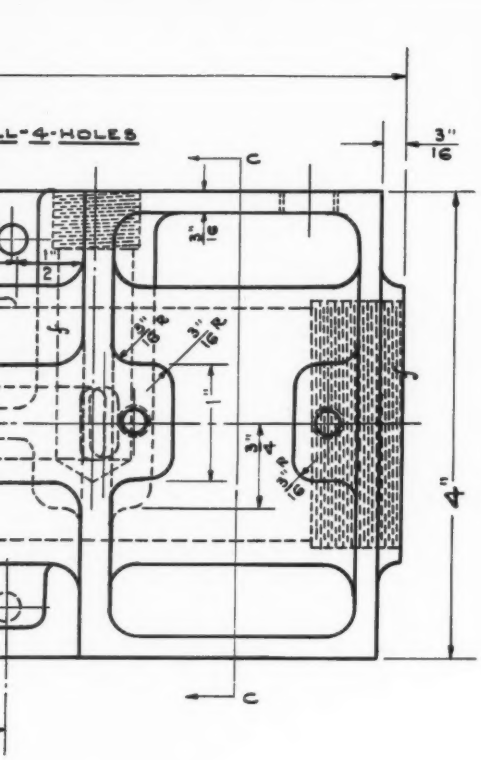
Submitted by C. H. Niemann, Hammond, Indiana. Described on page 346

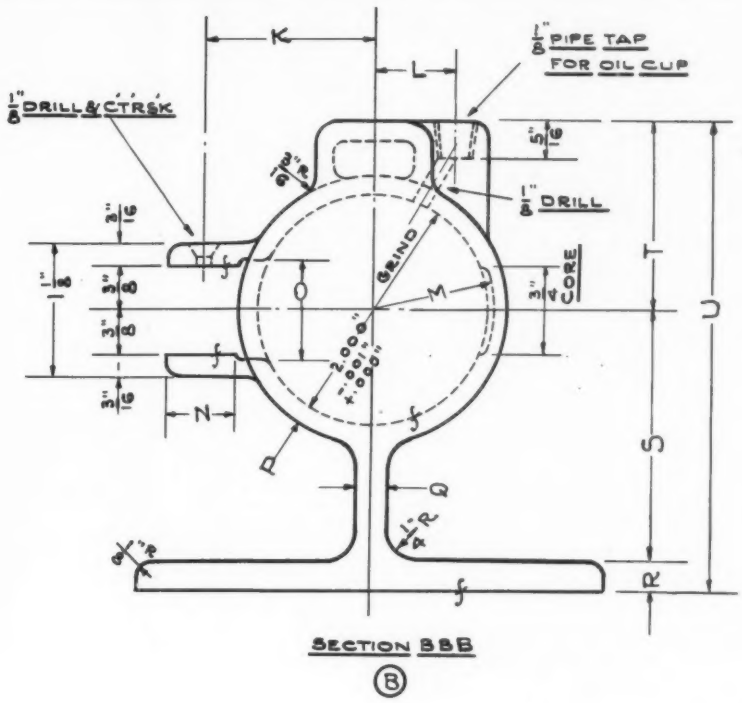
A TO Z ON THE DRAWING OF THE GAS ENGINE CYLINDER
SHOW VIEW (B) IN CROSS SECTION. SHOW VIEW (C) IN CR

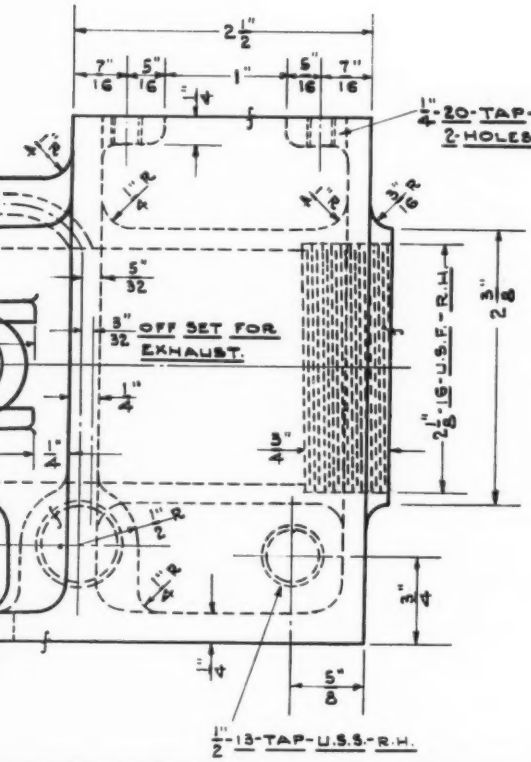


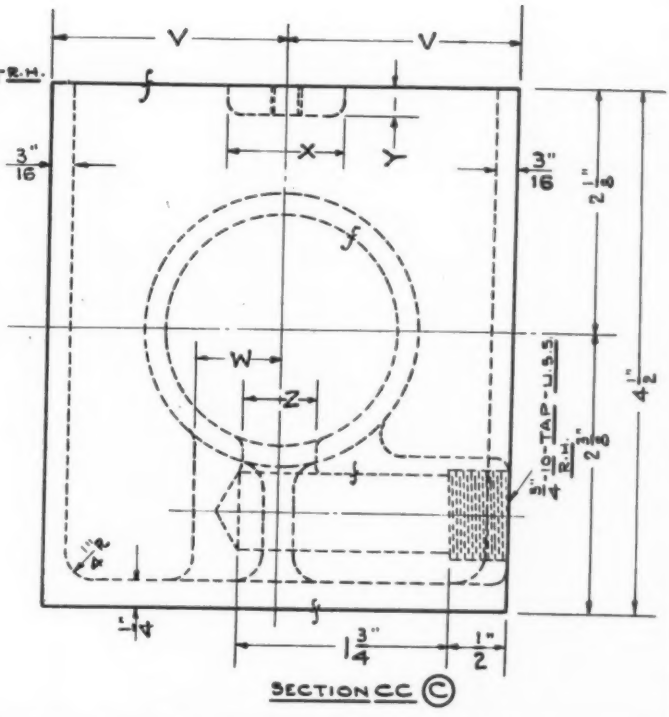
Submitted by C. H. Niemann, Hammond, Indiana. Des

...LINDER AND LIST THEM ALPHABETICALLY ON A SHEET OF PAPER.
...IN CROSS SECTION.









diana. Described on page 346

Girls and their Education

L. H. Harnsberger

Central High School,
St. Paul, Minnesota

Industrial-arts work for girls must be developed and offered as freely as it has been for the boys

The girl of today expects and is expected to be different in many ways from the girl of yesterday. If this be true, then her education must be different in many respects and must involve those subjects that will develop those desired differences.

The high-school girl dreams a very different dream from that which motivated her mother's ambitions; so the girl of tomorrow will have a new dream with its alluring possibilities which she must prepare to meet.

The Central High School of St. Paul has undertaken to give some of the needed instructions to prepare these girls for the lives which they have to live, by offering a course in industrial arts, which supplies certain information that can be classified as educational for girls who have no desire to take a purely academic course.

In this course the student is taught the use of hand as well as certain machine woodworking tools. Also the methods of construction, processes, and principles which are involved in the making of projects that develop ideals in workmanship, design, and finish. A liberal amount of supplementary information is given, including facts about tree growth, lumber manufacturing, cabinet woods and veneers, seasoning, and lumber defects. Special emphasis is placed upon wood finish, stains, staining, varnishing, refinishing, painting, and enameling with the necessary auxiliary information.

No cultural subjects are omitted from this course. Other features have been added that, we believe, are no less cultural.

The course requires one 45-minute period per day for 40 weeks and earns one credit. It is regarded as an advanced subject and is given in the third and fourth years. The course has become very popular and taxes the shop capacity for the two periods that can be allotted to the subject. The daily average attendance is 40 to 48.

The accompanying illustrations demonstrate how popular the course is with the girls.

The instructional element is somewhat difficult to administer, owing to the necessity of having four grades of work running parallel. The beginners start at zero having had no previous experience; therefore, a great deal of group demonstration and lecture work is necessary. For the benefit of those who have never had the training of girls in industrial-arts work, it may be well to state that it is much easier to put across a lesson to zero girls than a group of boys. The reason is simple. There is no conflict with former experiences and the girls listen and try to put into practice the instruction as given.

Instruction begins with a demonstration in the sharpening, adjusting, and use of the jack plane. Other tools are demonstrated in their sequence in the process of squaring stock which forms the first unit of learning. When the first unit of learning has been accomplished, each student has a piece of stock ready for her first project.

The squared stock is used in the making of a little pin tray with a simple incised design carved on either end. Practically all projects are embellished with appropriately carved designs. Process sheets are used to aid in remembering the oral instructions given.

Quarter-sawed red gum is used for all project work. Because of its uniform grain structure, it tools readily and finishes beautifully.

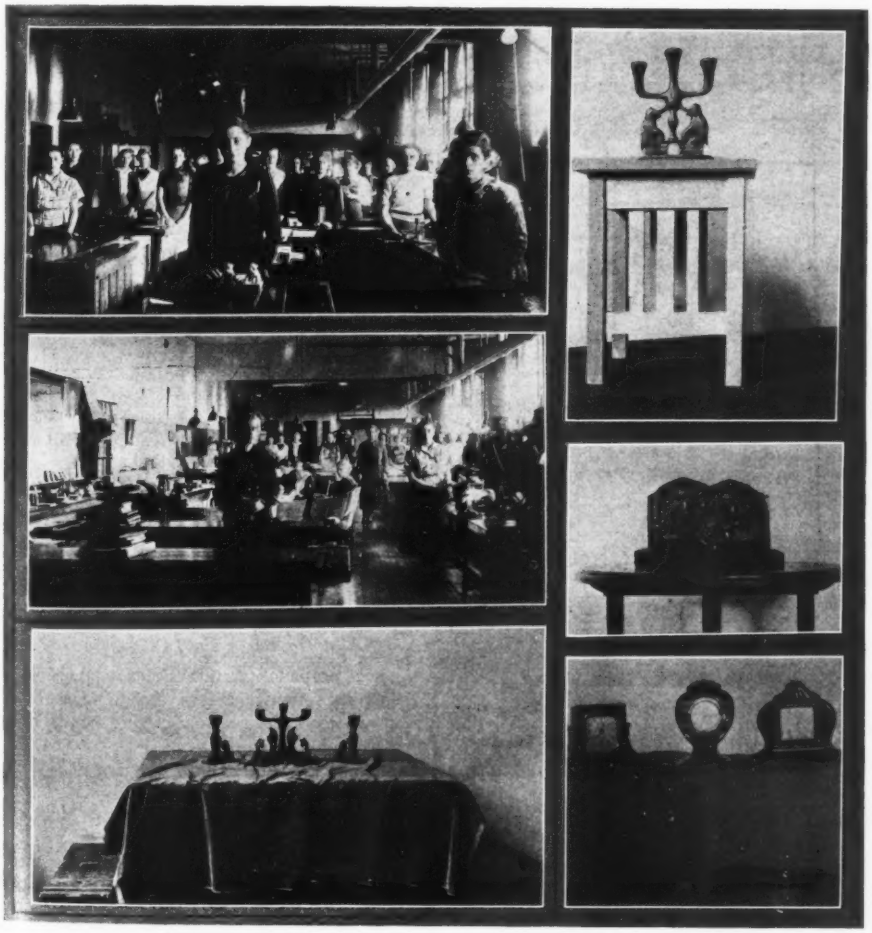
Beyond the first semester, students are given a very free choice of projects which may be suggested by the instructor or may be of individual creation. So far as practical, a group is expected to select the same project, thus permitting group instruction. An advanced student is usually appointed as an assistant to the teacher, and her duties are varied — aiding beginners in learning shop manners, sharpening tools, and being generally helpful about the shop.

A variety of projects is offered — book ends, lamps, candlesticks, picture frames, boxes, clock cases, and many others to choose from besides original projects which are a vital part of this course.

Ideals are stressed. No piece of work is accepted unless it reflects the student's best efforts. We have but one standard. All work, to be recognized, must grade 75 per cent or better. This is understood from the beginning, so there are but few failures — not more than one or two in a division of 48 girls.

The primary object of this course is to teach the girls to be better homemakers. In establishing a home, it is important to know something about each item that goes into its furnishing. The upkeep of a home makes many demands, and with the knowledge gained from this course, these girls are better fitted to supervise, if not to actually do the work themselves. We receive many encouraging testimonials from former students as to the value of this course.

Our equipment as well as our thinking is kept up to date, and with the splendid cooperation of our principal and supervisor, we have been able to put forward a program of instruction that is unique as well as helpful.



Girl workers and their products, Central High School, St. Paul, Minn.

Gauge Your Finish by Your Start

Carl H. King

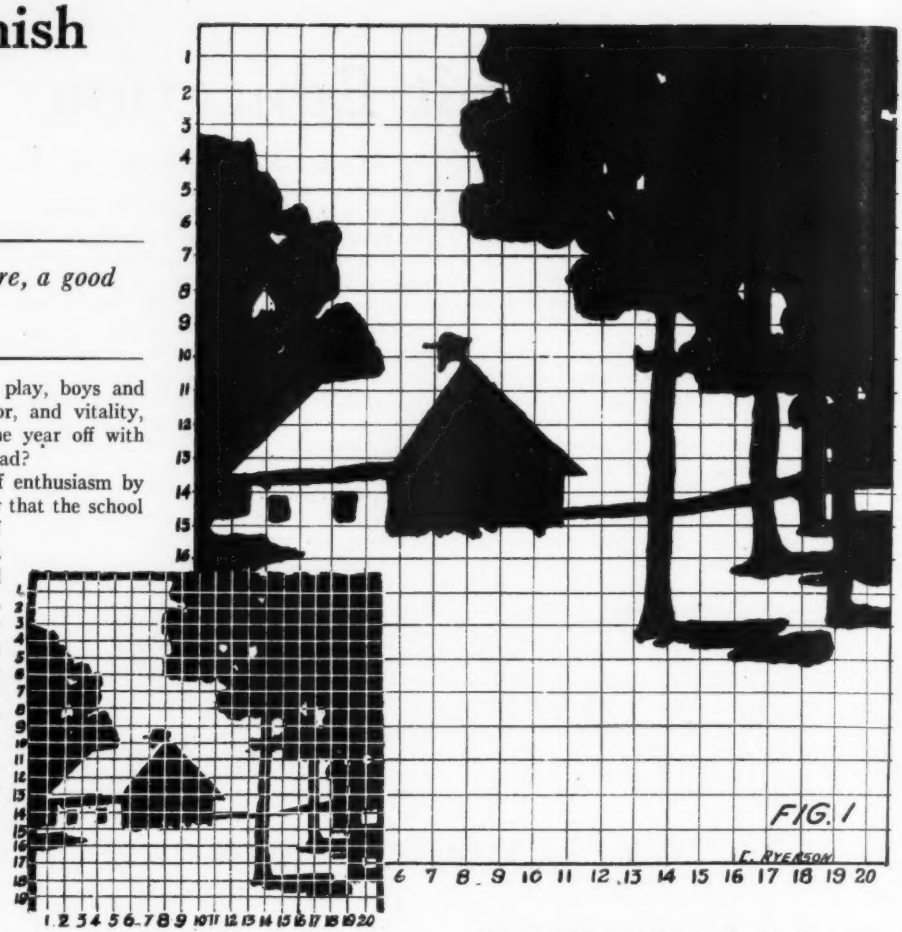
Township High School,
Pontiac, Illinois

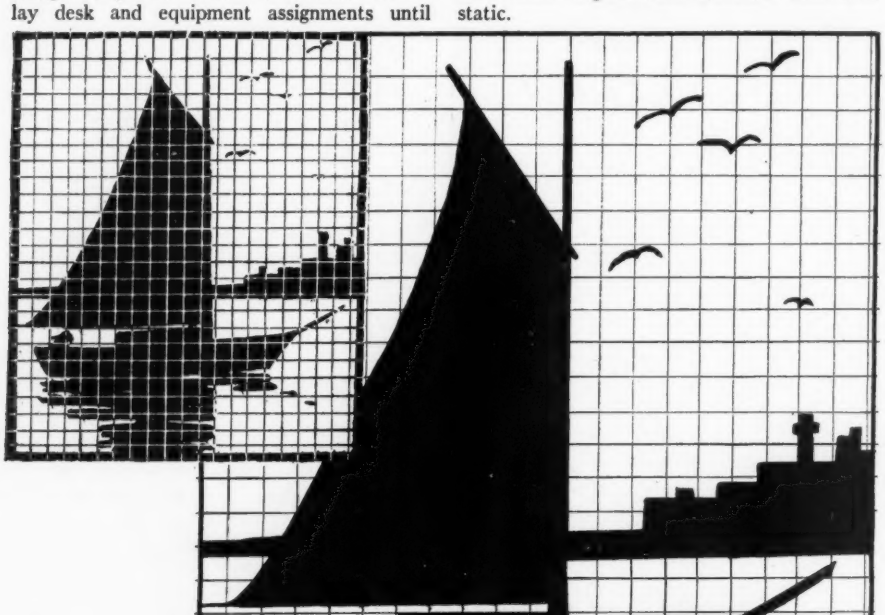
In the drafting room, as elsewhere, a good start engenders a good finish.

After the summer vacation of work and play, boys and girls will return to school full of vim, vigor, and vitality, rearing to go. Have you planned to start the year off with a bang? Are your sails set for full speed ahead?

You may capitalize upon this first surge of enthusiasm by starting your class at actual work the first day that the school gong is sounded. In this way, a precedent of good class habit will be started, and there is a likelihood that the enthusiasm thus engendered will continue throughout the year. Of course, the students' enthusiasm seldom if ever continues for long. The teacher, therefore, must be enthusiastic at all times, if he expects those with whom he works to respond in an enthusiastic manner. Above all, he must not be guilty of wet-blanketing that first surge of enthusiasm during the first week of school. More than most realize does the success of the school year depend upon the success of the first week of school.

In mechanical-drawing classes, there is always that problem of drawing supplies, drawing equipment, and desk assignments. While the class and schedule adjustments are being made, I have found it advisable to delay desk and equipment assignments until the school organization becomes somewhat static.





During this period of school adjustment, I have tried several schemes of meeting the existing condition and still make the most of this period of the school year. The piece of classwork described herewith serves well as a starting activity and requires but a limited background for the student, and a minimum of drawing supplies and equipment.

At the first short-session day of school, I give a list of needed equipment to be purchased, make the assignment for the following day, and briefly explain the content of the course. In the assignment, each student is asked to bring to class some suitable clippings from newspapers or magazines. Some examples of the work wanted are shown to the class. It is well also to have a supply on hand to supplant those which are not suitable.

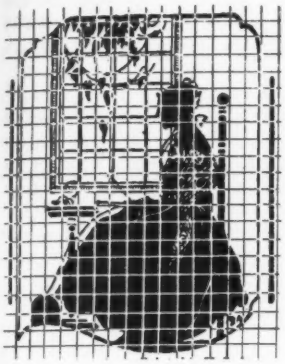
The following day, being the first day of actual classwork, the problem is presented. Each student makes an enlarged or a reduced sketch (by the graphic method) of the sketch chosen. Figures 1, 2, and 3 show type problems which may be used.

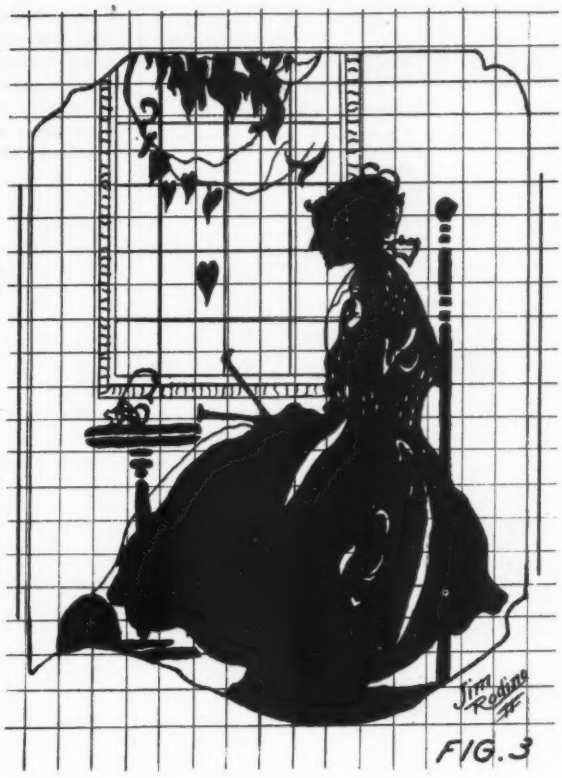
The problem permits the introduction of beginning practice in the technique of drawing vertical and horizontal lines with the T square and triangles, as well as of using the drafting scale for laying off distances. The problem offers practice in sketching curved lines through plotted points by freehand method.

This graphic method of freehand enlarging and reducing the sizes of sketches, pictures or drawings has many practical values for everyday needs of the average individual both in school and out of school. It has the faculty of

creating enthusiasm if not overindulged, largely because rapid progress is visible to the student. It also presents a fine method for bridging the gap between the freehand type of drawing with which the pupil is familiar, and mechanical drawing of which he has little or no knowledge.

Upon this as a first assignment, the course in mechanical drawing may be properly started without unnecessary delay, and a proper start made for the rest of the year.





Problems and Projects

WOODWORKING TEST — BRIEF STATEMENTS

G. T. Malbone, Piedmont Junior High School, Charlotte, North Carolina

Answer the following as briefly as possible:

1. Give the two methods of patching before staining.
2. Name four common cabinet joints.
3. Name three ways of telling various types of trees in the forest.
4. Give in order the dimensions of a board foot.
5. Lumber at $35 per C would cost how much per foot?
6. Give three ways of telling various kinds of cabinet woods in the shop.
7. Name two kinds of glue and give two advantages of each over the other.
8. Give three uses of the try square.
9. Name three kinds of hand saws.
10. How can walnut be distinguished from gum?
11. How can the approximate age of a log be determined?
12. What is the difference between a board and a plank?
13. Which way should the teeth point on a coping saw and why?
14. How can we prevent scratching when sanding on the lathe?
15. What is meant by incised carving?
16. Why use a block when sanding flat surfaces?
17. What determines the length of the shortest piece of wood that can go through the planer unassisted?
18. Give two advantages of a circular planer head over a square-head type.
19. Why is a nail and brad set concave at one end?
20. What is the difference between a bevel and a chamfer?
21. Why is it always best to keep two hands on a chisel when possible?
22. What is meant by hollow grinding?
23. What is meant by r.p.m.?
24. Give three reasons for staining wood.
25. Why will a planer or surfacer not take warp out of a board?

MECHANICAL-DRAWING TEST

M. R. Klein, Nathan Hale Junior High School, Cleveland, Ohio

Fill the blanks, indicating the meaning of the abbreviations.

1. Dia. .....
2. Circum. .....
3. C'sink. .....
4. C.L. .....
5. C'bore .....
6. Hd. .....
7. Sq. .....
8. Std. .....
9. Scr. .....
10. R. .....
11. C.I. .....
12. C.S. .....
13. C.R.S. .....
14. W.I. .....
15. T.S. .....
16. F.T.S. .....
17. L.H. .....
18. R.H. .....
19. Min. .....
20. Max. .....
21. Btn. .....
22. F.A.O. .....
23. B. & S. .....
24. App. .....
25. Fil. .....
26. Hdn. .....
27. B.W.G. .....
28. U.S.S. .....
29. H.S.S. .....
30. S.A.E. .....
31. Gr. .....
32. Dbl. .....
33. Hex. .....
34. Thd. .....
35. Mm. .....
36. U.S.F. .....
37. A.S.M.E. .....
38. M.I. .....
39. N.C. Thread .....
40. N.F. Thread .....

CANDLEHOLDERS

Gerald A. Boate, Seattle, Washington

A pair of copper candleholders of colonial design, at a cost of fifteen cents each, is exceptional value. In spite of their cheapness, however, they are durable and will last for many years. If candleholders are not desired, small test tubes may be fitted into the holders and presto! we have a pair of bud vases.

The finish may be buffed bright copper and lacquered, or it may be antiqued and waxed.

The project embraces some interesting operations and is well within the capacity of the seventh-grade boy who has had about 30 hours of benchwork. The handles are ring-shaped and riveted. In this way, this project is made to cover the riveting requirement for the boy-scout merit badge in metalcraft. The time required by the average boy to construct a pair of these candleholders is seven hours.

Material

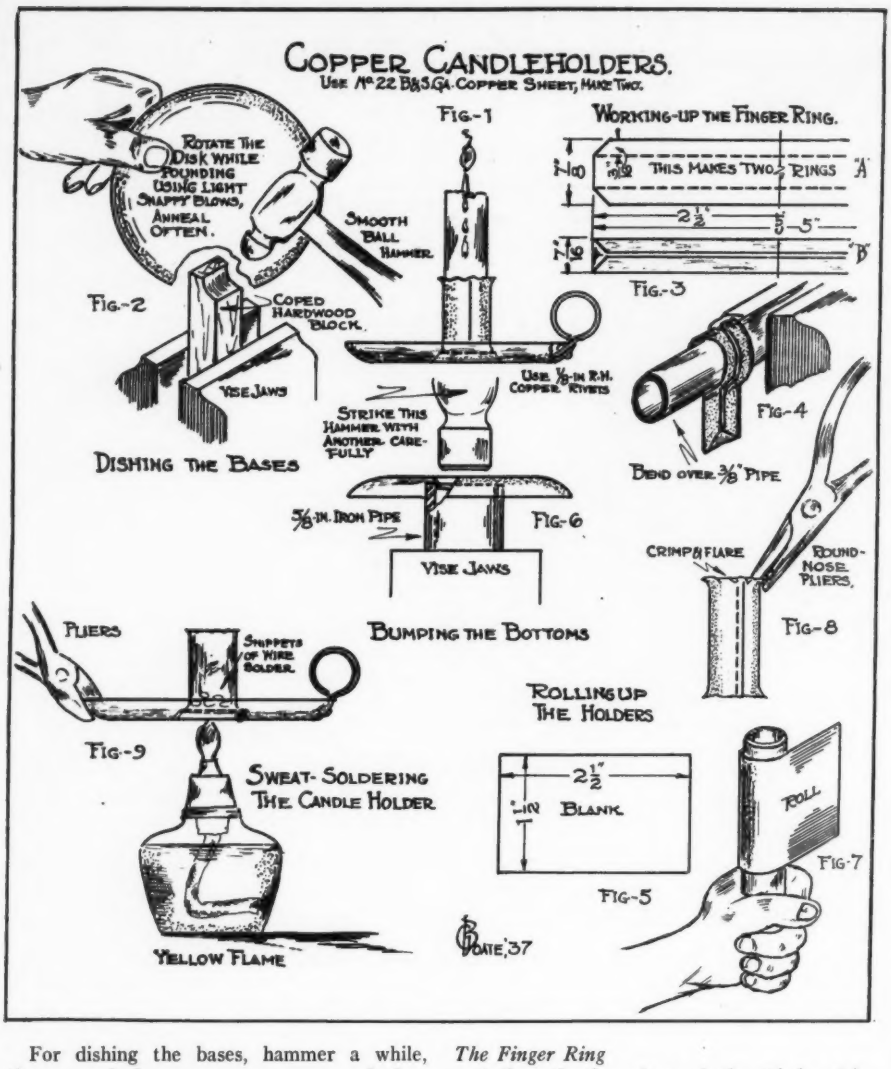
The material needed for making two candleholders is No. 22 B. & S. gauge, half-hard sheet copper cut as follows:

2 pc.	4¼ x 4¼	Bases
2 pc.	1½ x 2½	Holders
2 pc.	⅞ x 5	Finger rings
2	⅛ x ½	Oval-head copper rivets and burrs
1 pc.		Wire solder

Figure 1 and the halftone show how the holders look when finished.

A hardwood block 1 by 1 by 6 in. with the end coped will be needed for dishing the bases as shown in Figure 2.

The point to be kept in mind is that hammering copper hardens it, and continued hammering will crack it. To keep copper soft (plastic) while it is being hammered, it must be annealed frequently by heating it uniformly to a red heat and then plunging it into cold water.



For dishing the bases, hammer a while, then anneal, hammer some more, and then anneal again. Continue this until the bases are properly dished. The success you will have in doing this job depends largely on annealing.

Construction

The Bases

1. With a lead pencil, draw the diagonals on each of the 4¼-in. square pieces. Lightly center punch where the diagonals cross.

2. Set the points of a pair of dividers at 2 in. Using the punched center, draw a circle on both pieces. Use a scale and check that the diameter is 4 in.

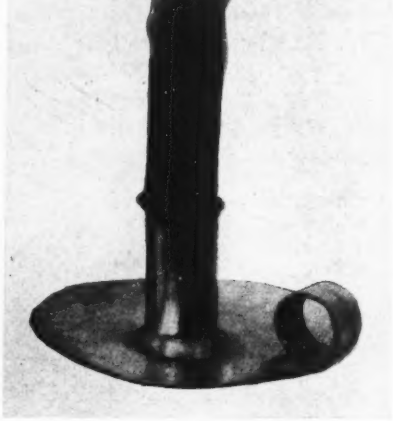
3. With a pair of straight-blade tin snips, cut out the circles and smooth the edges with a flat smooth cut file.

4. Place the coped hardwood block in the vise jaws as shown in Figure 2. Select an 8-oz. machinist's hammer which has a very smooth round ball. Hold a copper disk with its edge placed over the coped block and pound lightly while rotating the disk. Use light, snappy hammer blows, and anneal the copper often. Keep at it until the rim is smoothly sunk ¼ in. Keep working to make a pair that look alike. If any twist develops, it may be taken out by lightly tapping the inside or outside with the face of the hammer while the bases are resting flat on the bench.

The Finger Ring

5. Smooth the edges of the ⅞ by 5-in. strips, and then snip a little off of each corner as shown in Figure 3 at *A*. Set a marking gauge at 3/16 in. and draw a line down each side.

6. Fold these edges over as shown at *B*, Figure 3 using the bar folder or bending them over the edge of the bench, or over the vise jaws. Pound them down flat and smooth with a wood mallet.



Copper Candleholder

7. With the seamed side outside, form the two finger rings as shown in Figure 4. Use the 8-oz. hammer for tapping down. A ⅜-in. pipe is almost ¾ in. in diameter on the outside.

Forming the Holders

8. File the edges of the two 1½ by 2½-in. pieces of copper smooth. The blanks will look like Figure 5. With the same piece of iron pipe used for forming the finger rings, roll up the blanks with the 2½-in. side around the pipe as shown in Figure 7.

9. A pair of 6-in. round-nose pliers should now be used to crimp around both the top and the bottom of both holders as shown in Figure 8. Flare the edges outward as you crimp.

Bumping the Base Bottoms

10. Place a short piece of iron pipe having a ⅞-in. hole vertically in the vise jaws as shown in Figure 6. Turn one of the bases upside down centrally over this pipe then place an 8-oz. hammer as shown. Strike the ball of this hammer lightly with the face of another hammer. Anneal the copper and repeat until the base is raised ⅛ in.

Attaching the Finger Ring

11. How the finger ring looks when it is riveted on the base is shown in Figure 1. To attach the ring, two No. 6 rivet sets, a hand drill in which is inserted a ⅛-in. diameter twist drill, a center punch, and the hammer already used will be needed.

12. Center punch each finger ring in the center of the flat part, then clamp one corner of the flat part in the vise jaws and drill the rivet hole.

13. Fit the ring to the base as shown in Figure 1, and scribe where the hole in the base is to be drilled. Center punch and drill the hole. Remove burrs using a file.

14. Push one of the oval-head copper rivets through the hole which was drilled in the ring, then through the hole in the base, place a copper burr over the rivet shank and cut off the latter as close as possible with a pair of side-cutting pliers.

15. Place a rivet set vertically in the vise jaws and tighten the vise very tight. Holding the base upside down place the rivet head into the hollow in the end of the rivet set. Press downward and hold the rivet head tightly against the set. Flatten the rivet end slightly by striking it a blow with a hammer. Finish setting it down by placing the hollow of the other rivet set over it and striking the end smartly with a hammer. Make sure before the final tightening, that the handle is on straight.

Sweat Soldering the Candleholder

16. The crimped bottoms of the candleholders, Figure 8, should be polished with steel wool and a thin skim of soldering paste wiped around the inside edge. The upper surface of the "bumped-up" portion of the dished bases, shown in Figure 6, should also be polished but no soldering paste applied. Place the candleholders on the bases and see if they set properly.

17. Using a piece of wire solder cut off

eight pieces each not over 1/16 to ⅛ in. in length. Be sparing with the solder, otherwise you will have melted solder where you do not want it.

18. Place four of these small pieces of solder in each candleholder as shown in Figure 9. Use a small stick working the solder snippets out near the inside edge. One at a time heat the holders over a yellow flame, rocking them slightly, using either an alcohol lamp, a Bunsen burner, or a blow torch. When the solder is flowing, carefully lower the assembly into a pail of clean cold water.

Finishing the Holders

Both of the assembled holders should now be pickled. This is done by lowering them carefully by means of a copper wire attached to the handles, into a jar which contains a weak solution of nitric acid and water. The acid solution will at once start eating away some of the copper. After a few minutes remove the candleholders by the attached wires, holding them at arm's length, and wash them off in hot soapy water. If the pickle eats the copper, it will also bite you. Be careful.

Dry the holders thoroughly. Then polish them with No. 00 steel wool, after which they may be dipped into or brushed over with amyl lacquer (lacquer for brass), or an antique finish may be applied.

For the antique finish, use a solution made up as follows:

Boiling water.....1 quart
Liver of sulphur..Piece the size of a walnut

Test the solution for color, using a strip of bright scrap copper.

Copper wire should be used for holding while dipping. Both holders should be dipped at the same time. The operation should be done quickly because the longer copper remains in the solution, the darker it gets. When the right shade of darkness has been obtained, permit the holders to dry. Then they may be high-lighted with steel wool, after which the final finish of not less than three coats of floor wax rubbed to a shine, may be applied.

BIRD WINGS FOR MINIATURE AIRCRAFT

Terence Vincent, Ypsilanti, Michigan

Bird lovers may use the outlines of the bird wings for making miniature skycraft. The usual aspect ratio is six, that is, that the wing is six times as long as its average width. Bird-wing shapes may easily be adapted to simple pusher planes, such as the one described on page 184 of the May, 1929, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION. See also the article on "Flying Silhouette Airplanes," page 93 of the March, 1932, issue of this magazine.

Making the Bluebird Plane

Material

1 pc. 5/16 x 5/16 x 18	Medium balsa	Base
2 pc. 1/20 x 2½ x 15	Hard balsa	Wings
1 pc. ½ x ¾ x 8	Medium balsa	Propeller
4 pc. No. 8, ⅛ x 60	Flat para rubber	Motor
	Cement, silk thread, dye, .033-in. steel wire and glass beads	

Method of Procedure

If any of the balsa parts are too heavy, try to get similar pieces of balsa which are light and firm.

Select the proper color to give the balsa wood the correct tone of bluebird blue. The Diamond dye for vegetable fabric answers ve y well. Test the dye on a piece of balsa before using it on the wings.

A fine brightness is added by boiling the balsa about ten minutes in the color solution. Before placing the balsa into the dye, sandpaper the base, propeller, and the two wings smooth.

Cut the silhouette of the wing as if you were looking up at the bird while it is in full, leisurely glide, or copy the pattern shown in Figure 1. The correct spread is 15 in., but it may be made larger or smaller according to the wish of the builder.

When the wings are thoroughly boiled, allow them to dry in a steep dihedral with the edges from 2 to 4 in. above the midpoint. After they are thoroughly dry, the dihedral may be made permanent by giving the wings several coats of banana oil, sandpapering between each coat. If properly done, this will give the balsa wood a very fine highly polished surface. This same method of finishing may also be used on the base and propeller.

The end hook and propeller shaft should then be cemented in place.

With two of the No. 8 rubber bands attached to the propeller, place one blue wing under the motor base, about 6 in. from the front end, with the short edge of the wing forward, and the other wing placed similarly about 1 in. from the rear end of the motor base. The four-strand (two-loop) motor should hang slack (neither loose nor tight), between the end hook and the loop in the propeller shaft.

Flying Directions

With the wing tips up, and the propeller at the rear, grip the motor base between the wings of the airplane and toss the bluebird plane forward gently. If it glides ahead on a level, the rubber motor may be wound up and flown. If, however, the plane settles down on its tail (makes a tail slide), move the front wing back toward the propeller ½ in. or so, and glide it again. When the glide is satisfactory and level, wind up the motor 30 turns (so the wind blows *away* from the airplane, when the propeller twirls freely), and toss the plane forward but without jerking.

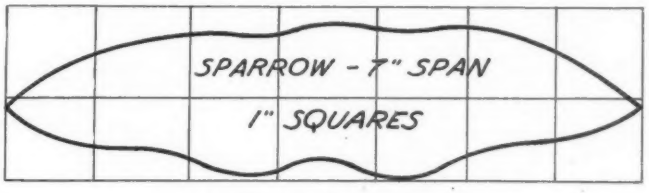
Use a stronger motor, if more speed is desired, or lighter parts and weaker motor, and 100 to 300 turns, if longer flights are wanted.

The Canary Plane

This plane can be made by following the directions given for the bluebird plane.

Material

1 pc. 3/16 x 3/16 x 12	Firm balsa	Base
1 pc. ½ x ¾ x 6	Light balsa	Propeller
2 pc. 1/32 x 2 x 7	Light balsa	Wings
4 pc. No. 8, ⅛ x 44	Flat para rubber	Motor
	Cement, thread, bearings sequins, dye	

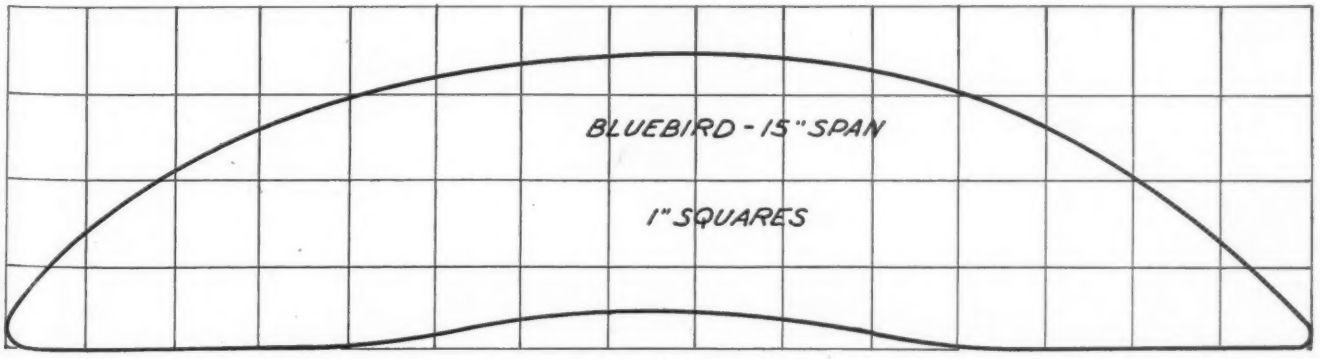


Layout for sparrow wing

Method of Procedure

Shape the parts, and smooth them with fine-grain sandpaper. Then boil all the balsa parts for ten minutes in the canary-colored dye, and dry as before. The dihedral may be as much as 4 in. for each wing.

When dry, the center parts of each wing should be covered with a thin coating of



Layout for bluebird wing

cement. This is to make the frail wing centers so firm that the rubber will not cut them during flights or landings.

The motor is on the *top* side of the motor base, and the wings are attached under the body.

The canary-colored propeller may be made very thin so that it will perform with feathery lightness. This airplane may be made to fly level, or in humpy jumps. You might even imagine the canary plane doing happy stunts. This may be achieved with shorter wings, a more powerful motor, and with one wing at the very front end of the base.

The directions for flying the canary plane are, of course, similar to those given for flying the bluebird.

A SIMPLE BUZZER

Carlton E. Beck, Lockport, New York

1. Square up the base to the size shown in Figure 2. Drill the two 3/16-in. holes and counterbore them 5/16 in. dia. and ¼ in. deep from the bottom. Drill also 1/16-in. holes ½ in. deep as shown in Figure 2.

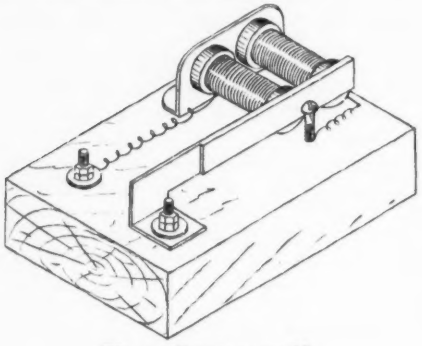


Fig. 1. Buzzer assembly

2. Cut the magnet support out of galvanized iron to the dimensions given in Figure 3. Drill the holes and bend the supports to shape. Fasten the support to the base with No. 5 by ½ in. r.h. screws.

3. *Coil Washers.* Cut off four pieces of ½-

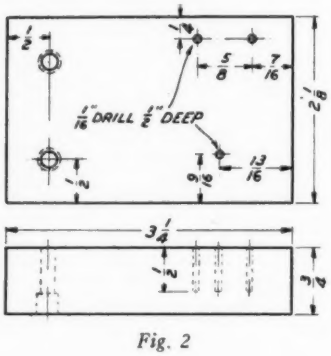


Fig. 2

in. dowel rod, ⅛ in. thick. Drill ⅛-in. holes through the centers. See Figure 4.

4. *Winding the Coil.* Slide the dowel washer on the No. 8–32 by 1-in. iron machine bolts. Insulate the bolt between the washers with paper and wind on six layers of No. 24 d.c.c. magnet wire for each. Twist the inside lead of one coil to the outside lead of the other. Then fasten both coils to the magnet support as shown in Figure 1. Shellac the two coils.

5. *The Armature.* Cut out a piece of 28-gauge galvanized iron as shown in Figure 6. Bend to shape as indicated in Figure 1.

6. *The Assembly.* Fasten the armature in

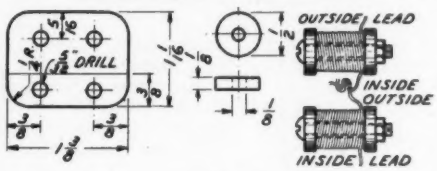


Fig. 3 *Fig. 4* *Fig. 5*

place. Use a No. 6 by ¾ r.h. brass screw as a contact screw. Before screwing this into place, put a piece of copper wire into the hole. See Figure 1. There should be 1/32 in. between the armature and the magnet. To adjust the armature so that it will touch the contact screw, loosen the nut holding it to the base, make the adjustment and then fasten the nut down firmly.

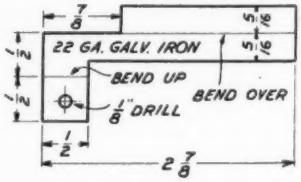


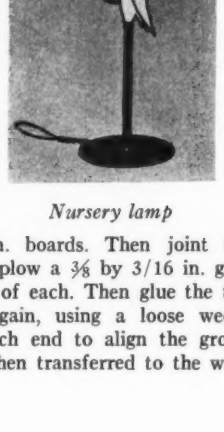
Fig. 6

7. *Electric Connections.* Connect the contact screw to one of the free leads of the magnet coil, and connect the other lead to the binding post as shown in Figure 1. The buzzer is then ready to be connected to the push button and battery.

NURSERY LAMP

Fred W. Bergmann, Cramer Junior High School, Camden, New Jersey

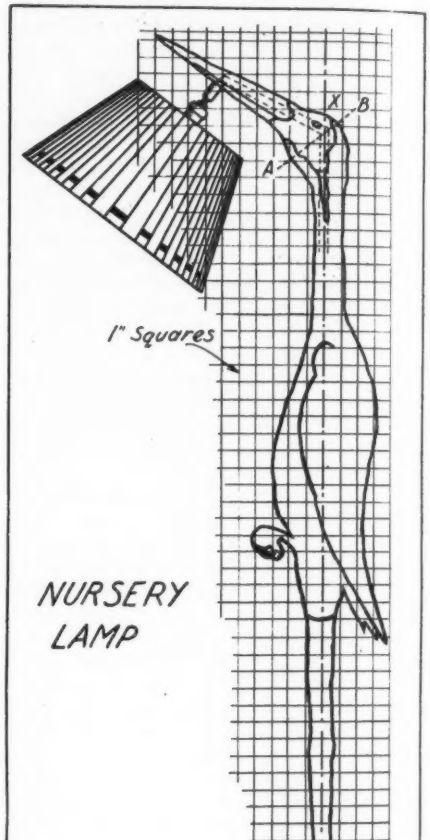
The nursery lamp illustrated and described herewith may be made of poplar. A piece 9 by 50 in. is large enough. Rip this board into



Nursery lamp

two 4¾-in. boards. Then joint the sawed edges and plow a ⅜ by 3/16 in. grove down the center of each. Then glue the two halves together again, using a loose wedge-shaped plug at each end to align the grooves. The design is then transferred to the wood, keeping the center line X-X' directly over the glued joint.

The head and beak from line A-B to the tip are separate pieces which are later on glued, the joint being strengthened with ¼-in. dowels. This part must be drilled for the wire as shown by the dotted lines, using a ⅜-in. auger bit.



Saw out the parts, and smooth them. The edges may be either well rounded or sanded just enough to take away the sharp corners. The lower end of the leg may be either left square and fitted into a mortise in the base or just fastened with long wood screws. The former is a stronger construction. A light wire, or a piece of strong twine must be fed through the head and body before assembling, in order to insert the electric cord.

The base should be 1⅛ by 8 by 15 in., and is best made oval so that no corners extend to be stepped on or tripped over. The leg should be fastened to the base about 5½ in. from the rear end to give better balance when the lamp and shade are attached.

Cut four toes, one 3 in. long, the others 2½ in. long, from ⅝-in. stock, shaped as shown, and fastened with glue and brads.

Three rubber-headed tacks can be driven

into the underside of the base, one in front and the other two toward the rear. These will give room for the electric cord and also prevent the lamp from rocking regardless of where it is placed.

The lamp can be finished to suit the personal whim of the maker. The illustration is in ivory enamel with the markings in black. The legs and base were finished with dark oak varnish stain.

The electric socket is fastened with a 1¼-in. brass-flange plate filed oval to fit the 1⅛-in. wood. Be sure to get a flange with male threads.

Key- or plunger-type sockets are preferable to the pull-chain type. Finally, be sure to get a good grade of well-insulated electric cord to wire this lamp, inasmuch as it is in direct contact with the wood throughout its entire length.

FLOWER VASE

Harry M. Dexter, Central High School, Grand Rapids, Michigan

The flower vase described in this article consists of an octagonal bowl and a cylindrical top. It may be made of brass, bronze, or copper. The bowl is 7 in. in diameter at the top, 4 in. in diameter at the bottom, and 2¾ in. deep. The upper part or neck of the vase is made of a 9½ by 7-in. piece of the same kind of material of which the bowl is made. This piece is formed into a cylinder and the edges are brazed together with a lap joint. The brazed seam is then filed smooth on the outside edge, and as much spelter as possible is scraped off. Then the joint should be gone over with a fine file and sandpaper. The cylinder, with seam on top, is then placed on a round mandrel, after which the seam is hammered with a heavy hammer until the lap joint becomes more or less flattened out. This, however, cannot be done in one operation, for the hammering makes the metal hard and brittle. Therefore, after a little hammering, the cylinder must be annealed, then the seam is hammered some more, and the cylinder is annealed again. This process is then continued until the seam is perfectly smooth. Never attempt to hammer a brazed seam while hot because it is sure to crumble.

Next check the cylinder to see that it is perfectly round and that both ends are level and smooth. Then flare out one end of the cylinder until it is large enough to cover the entire top of the bowl (see Fig. 2).

To join the cylinder to the bowl, turn up the end of the cylinder that has been flared out, and locate the bowl, bottom up, centrally upon it (see Fig. 3). Remember that articles that are to be brazed must be absolutely clean or otherwise the brazed joint will be imperfect.

For brazing, use a medium-grade spelter mixed with about 40 per cent powdered borax and plenty of cold water. Stir this thoroughly until the water appears milky. Then, with a spoon, pour some of this water, spelter, and borax mixture all around the burr of the cylinder close to the edge of the bowl, and heat the article slowly with a blue gas flame in order to dry the wet spelter. As this dries, the borax will assume the appearance of popped corn. Just as soon as this has happened, concentrate the heat at one spot of the deposited spelter until the article becomes red hot and the spelter begins to melt and run freely. Then continue this process until the article is brazed all around. In case the spelter is stubborn in some spots and refuses to melt, a little dry powdered borax thrown on that spot will generally encourage the spelter to melt. Heating must be very vigorous, or otherwise the spelter becomes oxidized too much and the color at that spot becomes an ugly yellowish green. If this happens, it is advisable to immediately cool off the article in fresh clean water, scrape off the oxidized spelter, and repeat the whole process. After the spelter has melted and run freely and smoothly all around where the bowl and cylinder touch, the joint between the two parts will be quite strong. Next, the article should be thrown into a suitable pickle and left there until all burnt borax has dissolved and has entirely disappeared from the surface. To hasten this removal of burnt borax, it is often necessary to boil the article in diluted sulphuric acid for about ten minutes. After the brazed article has been taken from the pickle, soak it for about ten minutes in a very strong sodium chloride and water solution. This removes the traces of borax which may still be present. When removed from this solution, the article should be rinsed off with cold water and

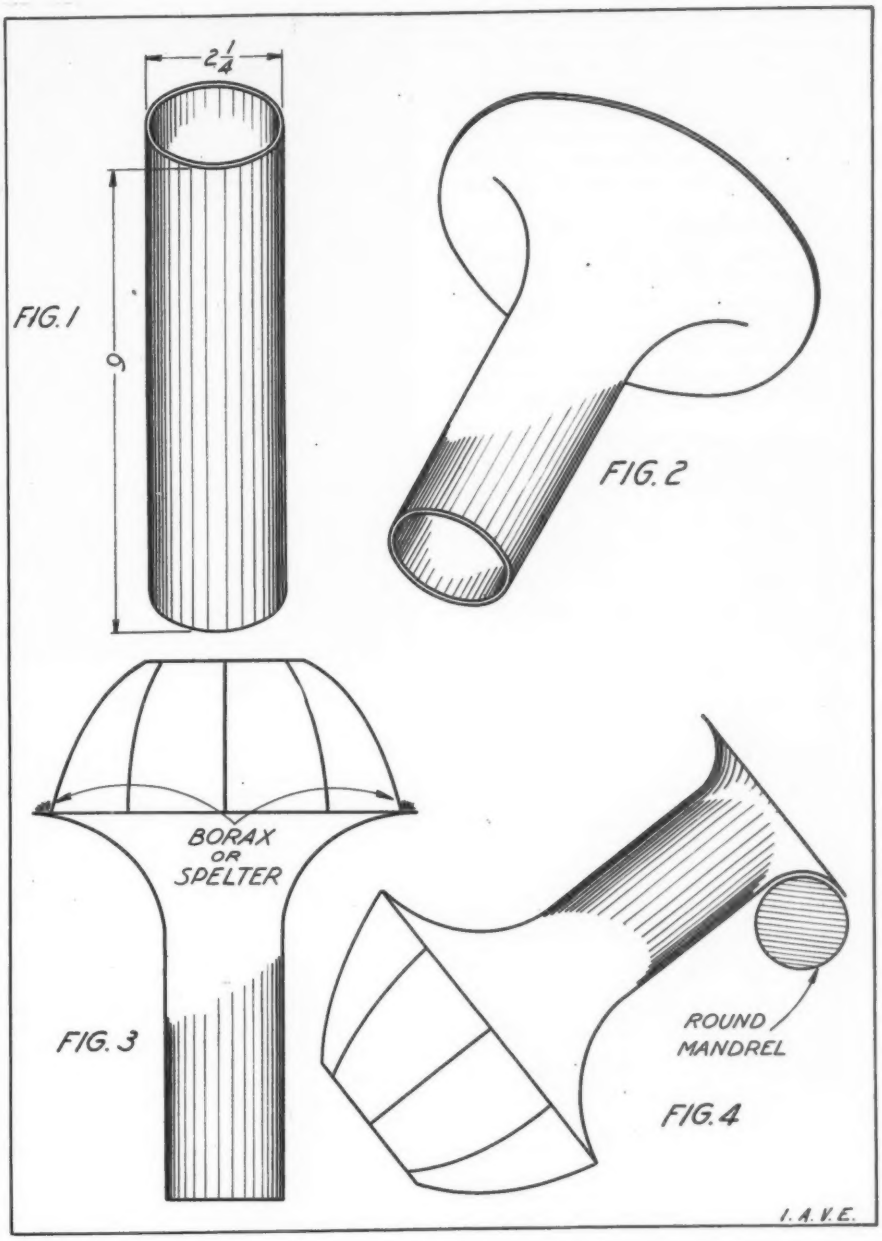


Fig. 1. Cylinder for neck of vase. Fig. 2. Cylinder flared out at one end. Fig. 3. Smaller end of neck turned down with larger end up. The bowl is placed on top of this with bottom up. Spelter is around edge of bowl. Fig. 4. Illustration showing round mandrel

scrubbed with fine sand or powdered pumice stone. Do not use hot water as this will cause the article to become badly discolored.

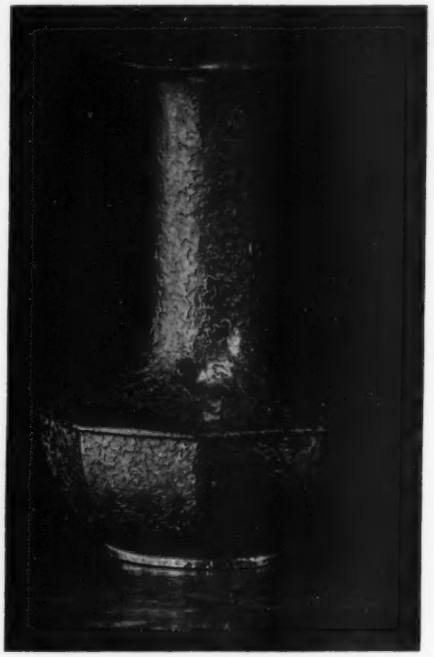
Next, trim off the excess burr around the brazed joint so the top assumes the octagonal shape of the bowl. This trimmed-off edge should be carefully filed nearly to the edge of the bowl and also smoothed off with sandpaper.

The next process is to flare out the top of the vase neck. This is done by placing the neck about 1 in. below the top over a round mandrel about 1¼ in. in diameter, and striking the inside with a ball-shaped raising hammer (see Fig. 4). While doing the hammering, keep turning the vase slowly. Be careful not to strike the edge, because this would cause it to tear.

Naturally, if an article is brazed, it will be soft and will not have a finished surface. Therefore, prepare a pitch made by mixing plaster of paris and some tallow into melted rosin. See that the vase is thoroughly dry inside, and then fill it with the melted pitch. After the pitch has cooled off, preferably over night and in a cool place, start planishing the vase over the whole surface. This will cause the whole vase to become smooth, shiny, and hard. During this planishing, small irregularities in the surfaces may be corrected. After the entire surface of the vase is smooth and of the right shape, it should be prepared for the etching process. To do this, go over the entire article with fine steel wool, and do not touch any part of the cleaned surface with your fingers. Next, take a ¾-in. coarse bristle paint brush, and with the scissors cut the bristles to irregular lengths. Do this at random, cutting the ends of the bristles while keeping the brush moving back and forth between the fingers. Also, cut a little bunch from the center of the brush.

Next, dip the brush into black asphaltum varnish, being careful to dip it just deep enough to get the varnish only on the ends of the bristles. Then, stroke the whole surface of the flower vase with the ends of the brush. While doing this, keep the brush turning back and forth between the fingers so as to create irregular spots of black and clear metal over the whole surface of the vase. Naturally, while doing this, the brush must be dipped into the asphaltum again and again, until the entire surface of the vase has been treated. The entire bottom of the base should be given a solid coat of the varnish. The top of the vase, and the surface just beneath the top should also be painted black. Allow the varnish to dry, preferably for ten to twelve hours. It is important that during the drying process the vase should be kept cool, for otherwise the asphaltum will run and will later peel off in large patches during the etching process.

Next, prepare in a deep earthenware crock, a weak nitric-acid solution for etching purposes. It should be diluted sufficiently so that the etching will not be done too rapidly. Lower the vase into the etching acid up to the top edge of the vase. Do not let any of the acid get into the vase. Watch the action of the acid during the etching process, and if the bubbles rise too rapidly, dilute the solution with a little cold water. If brown smoke



Flower vase

should appear to rise out of the solution at any time, weaken the solution immediately with water, for otherwise the job will be spoiled. This smoke shows that the solution is heating up to the point where the asphaltum may peel off, thus spoiling the entire work. Lift the article out of the solution about every five or ten minutes, and examine it to see if the etching is deep enough. Do not let it become too deep, because if this happens, the metal may become perforated at one or more places, thus spoiling the entire article. When the article has been etched to the proper depth, remove it from the acid and rinse it immediately with cold water. Then remove the asphaltum from the surface with turpentine or gasoline. Gasoline serves just as well as turpentine for this purpose, and is less expensive. After all traces of asphaltum have been removed, wash the article with water, and then dry it immediately in sawdust.

Next, remove the pitch from the inside. To do this, tie a wire around the vase and hand it bottom up with the opening over a large dish. Then, slowly heat the mouth of the vase with a gas flame until the pitch starts running out of it. Use a blue flame for this, as a red flame places a smoky deposit upon the metal which is hard to clean off. Do not heat other parts of the vase too soon, for that causes the pitch to expand on the inside and to burst the vase. Therefore, heat the other parts very slowly until all of the pitch is melted out. Be especially careful not to overheat the metal, for this would ignite the pitch and that in turn would anneal the vase which would be very undesirable.

To remove traces of pitch left on the inside, fill the vase with gasoline and let it stand for about an hour. Then empty the gasoline, and it will be found to have removed all traces of pitch from the interior. Stuff waste into the vase to dry out the inside.

BANDY-LEG PEDESTAL TABLE

Deane E. Eldridge, Junior High School, Plymouth, Massachusetts

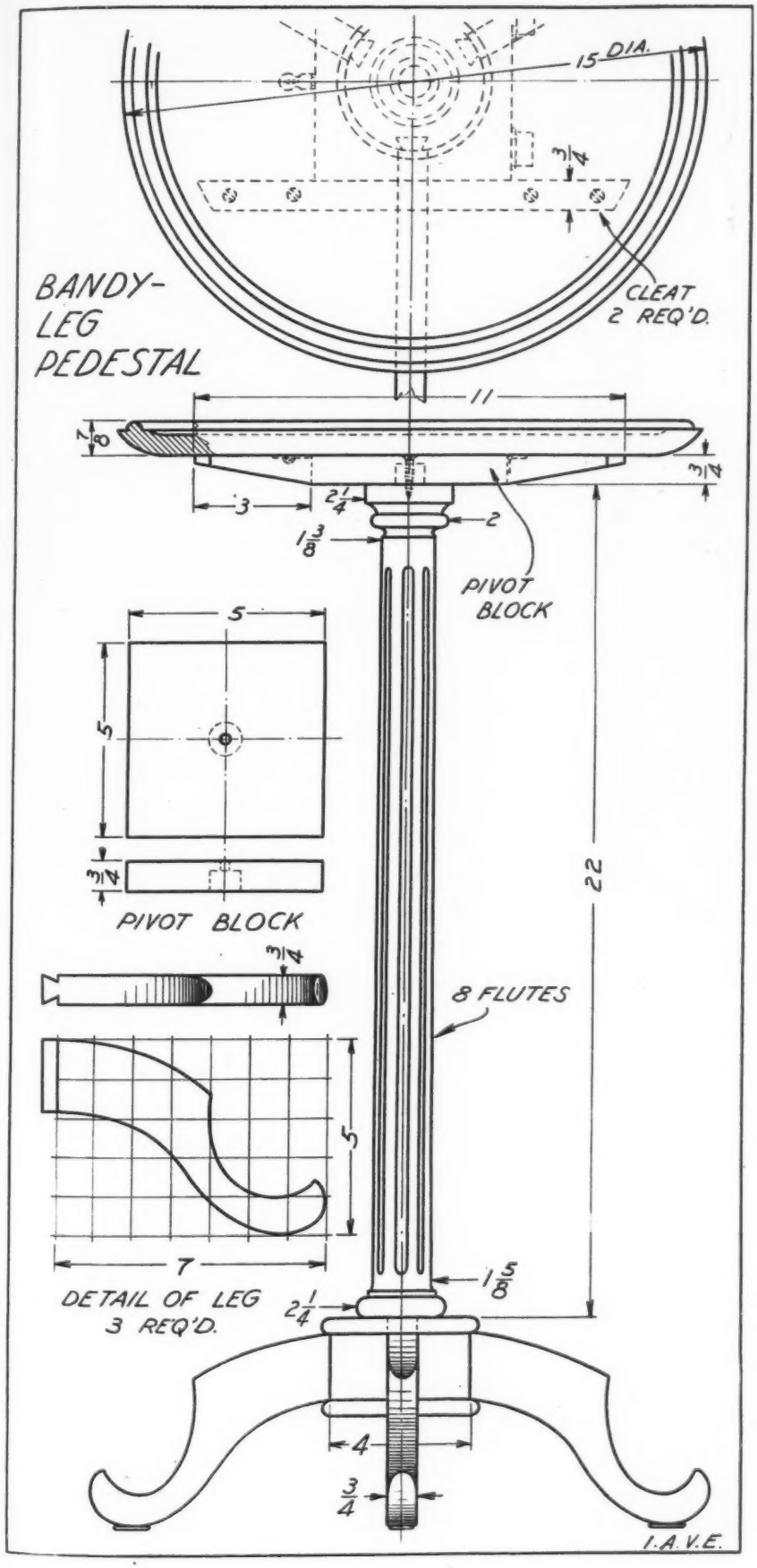
Of the many styles of pedestal tables of colonial origin which the writer has had occasion to measure and reproduce, this is by far the most unique. For the lack of a better name, it has been called by the above as a means of distinguishing it from the many other styles of pedestal tables used in our classes. Both the unusual contour of the legs and the method of attaching them to the upright, lend a new idea to something which in reality is quite old.

There is much to be said in favor of this project for shop use. Its many parts, most of which are small, give a great number of tool processes with the use of a small amount of material. Much of the work can be done to advantage on the lathe, which is more accurate and interesting to the beginner than shaping by hand. A large amount of manipulative hand skill is gained from such operations as tapering cleats, shaping legs, drilling and countersinking, dovetailing, and boring, to say nothing of fluting, which, however, may be omitted without spoiling the general appearance.

Bandy-leg pedestal table

An interesting bit of faceplate work is encountered in turning the rimmed edge on the top. If possible this should be carried out since it improves the appearance of the table and is in keeping with the method used in preparing these table tops in colonial times. A table of this small dimension need not have the tilting top, but boys enjoy putting on this feature, and to them it makes the table much more complete than otherwise.

The accompanying detail and assembly give a clear idea of the table's construction. By starting this project with the easier parts,



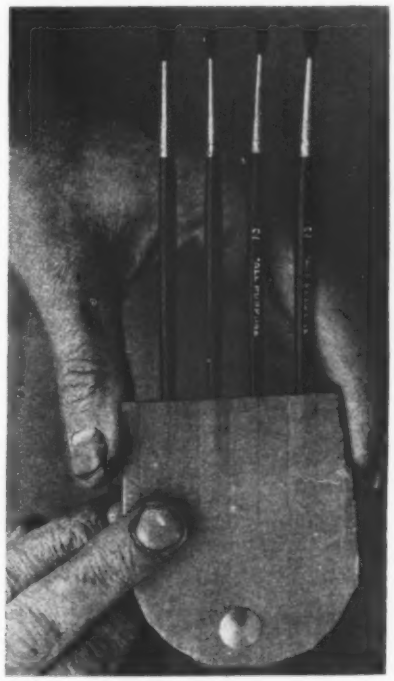
little real difficulty is found in carrying the work through to successful completion.

The woods best adapted for this table are mahogany or maple. Both of these woods were extensively used by the early cabinetmakers. The characteristic rubbed shellac finish, or the boiled-oil finish, will both give desirable results.

HOLDER FOR SMALL ART BRUSHES

Frank Bentley, Clinton, Iowa

Frequently a number of small brushes are used at the same time on work requiring trimming and decorating. If they are used in different colors, they must, of course, be kept from contacting each other. To do this, cut



Small-brush holder

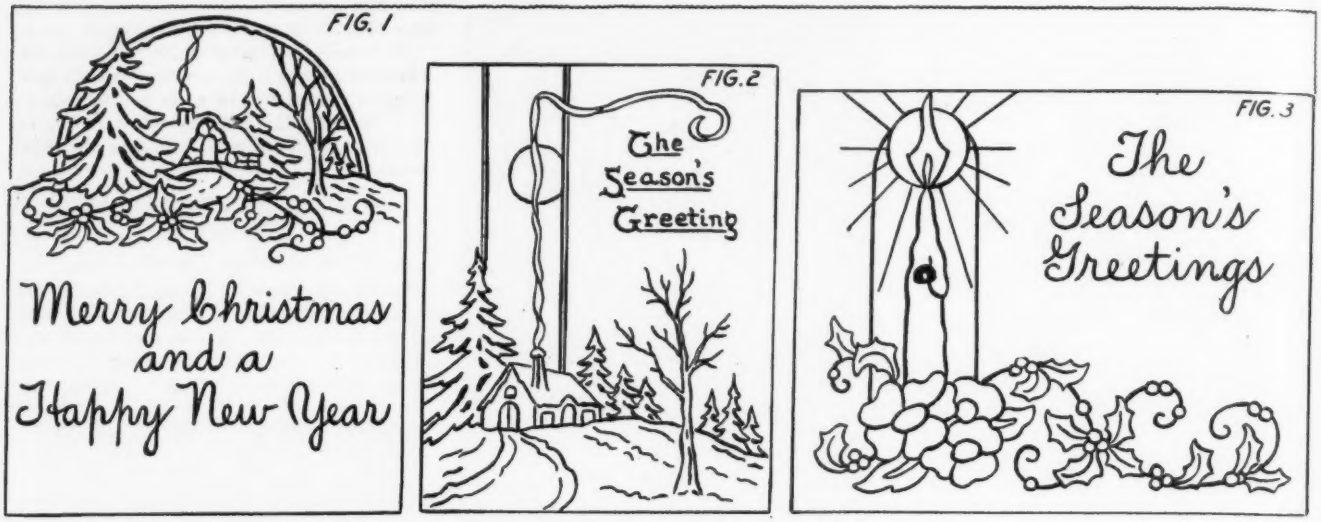
out a small block or piece of corrugated cardboard. Simply stick the tapered ends of the brushes in the holes or corrugations as shown, a half inch or so apart. A thumbtack can be used to hold both block and brushes at some handy place on the bench.

THE DRY-POINT METHOD ON CHRISTMAS CARDS

D. Elizabeth Roberts, Philadelphia, Pennsylvania

By the method known as "dry point," one can, with little trouble, make one's own plate and print as many cards as needed.

First trace the chosen design on a piece of tracing paper or firm tissue paper. Place this tracing on a board with the wrong side up. Then place over this a piece of clear celluloid, fastening it to the board with thumb tacks. Scratch the outline on the celluloid, using any sharp pointed instrument, as an awl, ice pick, or sharpened nail. Make these scratches as deep as possible, without cutting through the lower surface.



Christmas cards made by the dry-point process.

Ink this plate with printer's ink, spreading it on with a brush or knife and rubbing the ink in the outline with a soft cloth. Oil paints, either black or some dark color, also may be used, but the ink gives a darker outline. Wipe off the surplus ink or paint with a soft cloth, allowing the paint to remain in the outline. If some talcum powder is rubbed over the surface around the outline, without getting any in the ink, a cleaner print will result.

For the print, use thin Japanese paper with a slightly rough surface, or any thin paper that is not too smooth. Dampen this by rubbing lightly over the surface with a moist sponge or piece of cotton. Lay the plate over this, with the inked surface next to the paper and pin down to a board with thumb tacks. Rub over the plate with the bowl of a large spoon, or a roller, or the base or edge of a glass caster cup. Use a rotary motion when rubbing and as much pressure as possible. Lift the edge of the paper and if any places need to be darker, rub these again.

Ink the plate again and print as many cards as desired. If the ink dries on the plate, wash off with gasoline or benzine before inking again.

When the paper prints are thoroughly dry, tint them with water colors. Cut out the card along the marked edge, using scissors or a sharp knife. Mount on a heavy colored paper, using paste only on the edge or in the corners. A good effect is obtained by first mounting the print on a piece of gold or metallic paper, leaving a narrow edge showing, and then mounting this on a darker background paper. Red, green or orange tinted papers for backgrounds make attractive cards.

Design No. 1. Color the sky a bright blue with a touch of yellow at the horizon. Put touches of yellow and blue on the ground. Make the trees green edged with white, the tree trunk and upper border of the card brown, the holly leaves a bright green and the house and berries red.

Design No. 2 is tinted in a similar manner to card No. 1, making the moon and the windows of the house a bright yellow. This design makes a very good folder.

Design No. 3 also would be suitable as a folder. The flowers are bright yellow, with orange centers, the holly red and green, the flame of the candle orange, the candle and circle at the top red, with gold for the background around the candle and the flame.

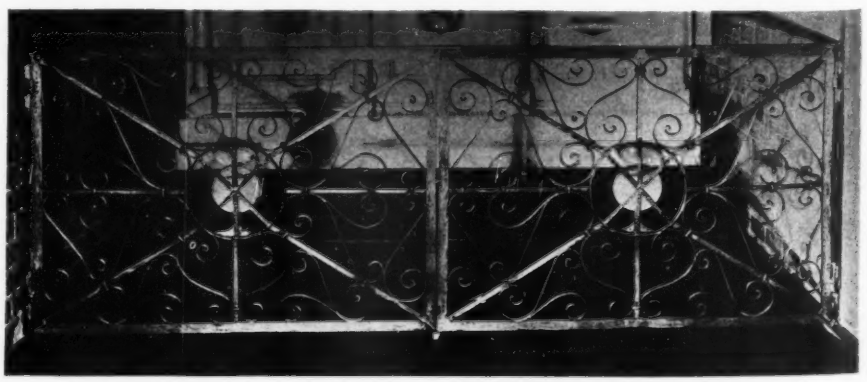
To make an envelope, use either white paper or paper tinted like that used for mounting. Cut a piece twice the measurement of the short dimension of the card, plus about an inch, and for the width, the measurement of the long dimension, plus about two inches. Place the card in the center of this piece of paper and fold over the card. Cut off the extra inch on each side of the flaps, leaving this strip in the center to fold over the card. Fasten the envelope with Christmas seals.

SANCTUARY GATES

H. M. Andersen, J. Sterling Morton High School, Cicero, Illinois

The metal gates illustrated here are not intended to supply an exercise in actual construction, but rather to offer ideas in design and use of materials that may be useful as applied to some similar project.

These gates contain religious emblems which are worked in as part of the design. The chi-rho, representing the sign of Christ, the chalice, and the bread, form a unit in the center of the gates. Black sheet iron was used for the chalice and the bread, and ⅛ by ½ in. wrought iron was used in the construction of the chi-rho. As the hinges were to be the sole support of the gates, channel iron 1 by ½ by ⅛ in. was selected for the outer frame of the gates to assure a degree of lightness. The scroll framework is of ½-in. square material, turned down at the ends and riveted onto the circle at the center, and into the frame at the outer ends. All scrolls are of ⅛ by ½ in. material forged to a taper and scrolled over a template. Since a feeling of delicacy was desired, the scrolls were placed so as to show their edges. The cap along the top of the gates is of ¼ by 1½ in. material riveted in place. A simple slide catch was made to fit over the cap. The construction of the hinges can be readily seen from the illustration. A stop was placed in the center to take some of the weight from the hinges when the gates are closed.

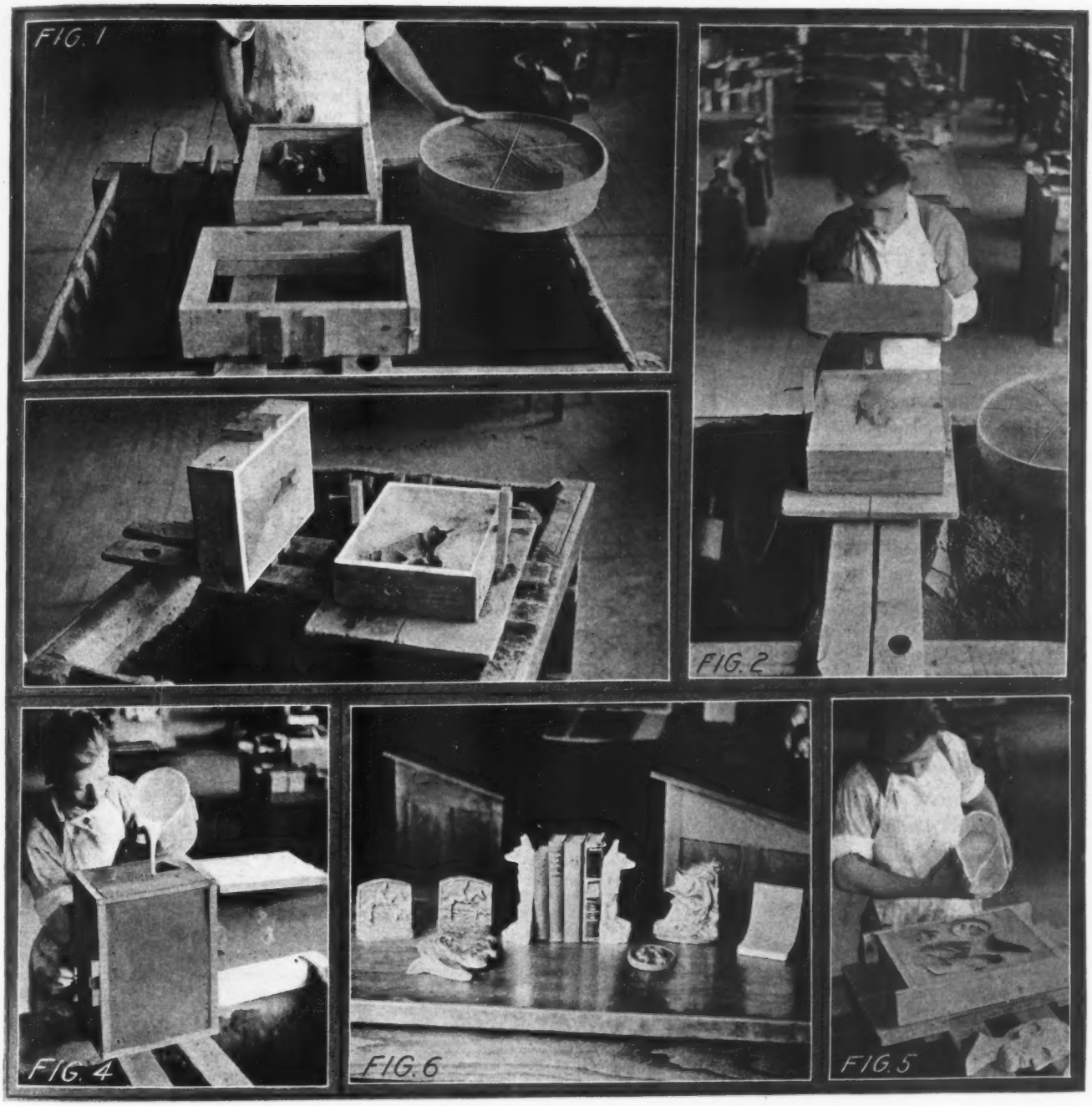


Sanctuary gates designed and made by H. M. Andersen, Cicero, Ill.

CASTING KEENE CEMENT IN SAND MOLDS

Roy M. Carter, and Paul V. Wilcox, Westport Junior High School, Kansas City, Missouri

Work with Keene cement or casting plaster is rapidly developing as one of the popular crafts in a great many industrial-arts shops. A number of magazine articles have pointed out the possibilities of using this material in various ways and the scope of the work is



Casting Keene cement in sand molds

gradually increasing.

The process of casting metal in sand molds is accepted as a common practice. The process of casting cement objects in sand molds, however, has not been so widely used. It is the purpose of this article to open to the readers of this magazine the possibilities of combining the two types of work and thereby increasing the range of articles which may be made.

This method of making decorative objects has two distinct advantages in its favor. First, Keene cement is not so expensive as are the metals commonly used for casting, and the sand offers an inexpensive medium from which molds can be made. Second, Keene cement can be handled by the boy without danger of burns which the molten metal might give him.

Those shops which are already equipped for metal casting will have few changes to make to prepare for casting with Keene cement. The main difference is in having a flask which can be locked together and one end hinged through which the Keene cement can be poured into the mold.

Ingenuity must be used in executing some of the more difficult pieces and the process is adaptable only to those castings which will have sufficient strength when made of cement. It is advisable to experiment on some simp'e castings before attempting the more complex.

For those not familiar with casting methods, the following procedure for casting a set of book ends is briefly as follows:

1. Select pattern to be cast.
2. Place cope on pattern board.
3. Place pattern in cope with base in contact with hinged end of cope. See Figure 1.
4. Dust on parting sand.
5. Fill cope with molding sand and ram down firm.
6. Place bottom board on cope and roll or turn cope over.
7. Remove pattern board and place drag in position. See Figure 2.
8. Dust on parting sand.
9. Fill drag with molding sand and ram

down firm.

10. Separate cope and drag.

11. Sponge around pattern with a water bulb or a swab of cotton waste.

12. Rap pattern to loosen it in the sand.

13. Draw pattern from sand. See Figure 3.

14. Replace drag and cope.

15. Lock cope and drag together.

16. Turn flask on end with hinged end up.

17. Open end of flask.

18. Prepare a sloppy mixture of Keene cement.

19. Pour into mold and allow to harden. Figure 4. (Fig. 5 shows a casting being made in an open mold.)

20. Remove casting from sand.

21. Wash off sand and allow to dry.

22. Finish in desired manner, such as paint, enamel, bronze, and the like. Figure 6.

BLUEPRINT READING

C. H. Niemann, Hammond, Indiana

(See pages 334a and 334b)

The drawing of the gas-engine cylinder offers several jobs in blueprint reading as noted at the top of the drawing. The student is required to find the missing dimensions and list them alphabetically. In order to do this job, he must study the cutting plane of the sectional views in order to locate the missing dimensions on the sectional views.

The views A, B, C, are not sectioned because it is from these views that we get three additional jobs. The student is given a mimeographed sheet of these views and, as the instructions state, he is required to change them to cross-sectional views, thereby making it necessary for him to study the drawing of the cylinder at three different points.

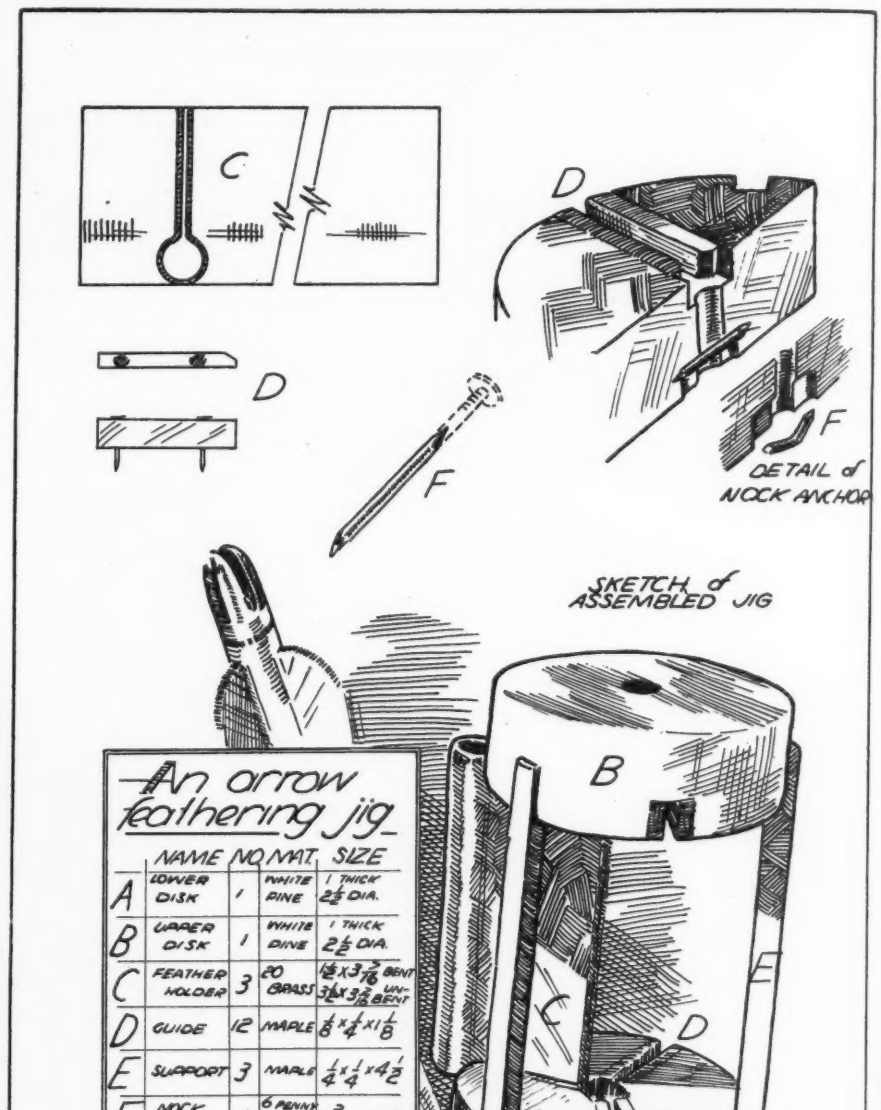
AN ARROW FLETCHER

George Welch, Lockport, New York

The fletcher described in this article consists of several simple parts. There are two disks, an upper and a lower, exactly alike except that the notches for the three supports, E, are made only half the thickness of the upper disk, but entirely across the lower one; and the lower disk has a nock anchor, F, which is not present in the upper. Three feather holders, C, bent of 20-gauge brass, press the feathers against the shaft of the arrow. These holders are led in at the proper angle (one at 90 deg., to the nock anchor) by guides, D, on either side of three slots, 120 deg., apart, in each disk. The supports, E, are glued and bradded rigidly in the grooves of the lower disk, but they are simply fitted tightly in the grooves of the upper so that the top can be removed for extraction of the fletched arrow. The most difficult accomplishment is getting the three slots between the guides in each disk, pointed at exactly the right angle in relation to each other, and toward the exact center of the arrow shaft. Adjustment can be made by removing the guides and substituting others of suitable difference in width to make up for any inaccuracy.

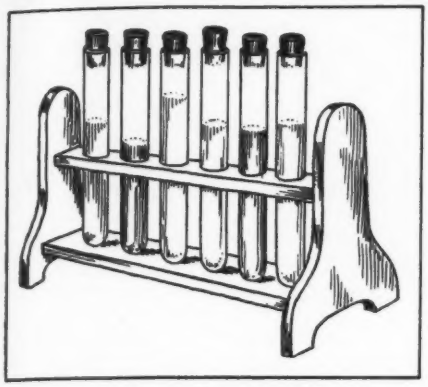
If enough material is laid out for making three or four of these fletchers, time will be saved when the actual feathering is attempted.

The fletcher in use


C
D
D
F
F
DETAIL of NOCK ANCHOR
SKETCH of ASSEMBLED JIG
An arrow feathering jig
NAME NO MAT SIZE
A LOWER DISK 1 WHITE PINE 1 THICK 2½ DIA.
B UPPER DISK 1 WHITE PINE 1 THICK 2½ DIA.
C FEATHER HOLDER 3 20 BRASS 1⅝ X 3 7/16 BENT 3½ X 3⅜ UN-BENT
D GUIDE 12 MAPLE ⅛ X ¼ X 1⅛
E SUPPORT 3 MAPLE ¼ X ¼ X 4½
F NOCK ANCHOR 1 6 PENNY NAIL ¾ LONG
① Guides, D, 3/32 apart
② Supports, E, fastened at bottom, not top.
George Welch '40
Buffalo State Teachers College
B
C
D
E
A

put turpentine in the shellac, or wash his varnish brush in alcohol?"

Even if the various containers are clearly marked so that there seems to be no chance



The test tubes used in the smelling test

for the boy to make such a mistake, yet mistakes do occur.

Boys are boys, and they are likely to ignore the signs in the containers, and so the instructor must be constantly on his guard, keeping a weather eye on his finishing department.

Boys like novelty, and they have found the test described herewith very interesting, and many of them find a fascination in repeatedly submitting themselves to it.

The practice is as follows. When a boy has reached the final stage on a project, he brings it to the instructor for the final O.K. before finishing. He also brings with it his job-plan sheet upon which he has indicated what type of finish he will use. After the instructor has asked the usual questions relative to the finishing process, he brings out his test-tube rack which contains six or more test tubes. These tubes contain the following agents: Water, gasoline, kerosene, alcohol, lacquer thinner, turpentine.

At random, the instructor picks out a tube and after first smelling it himself, gives the student a sniff. The boy must be able to recognize each by smell and tell its relation to the finishing process he is to use on his project.

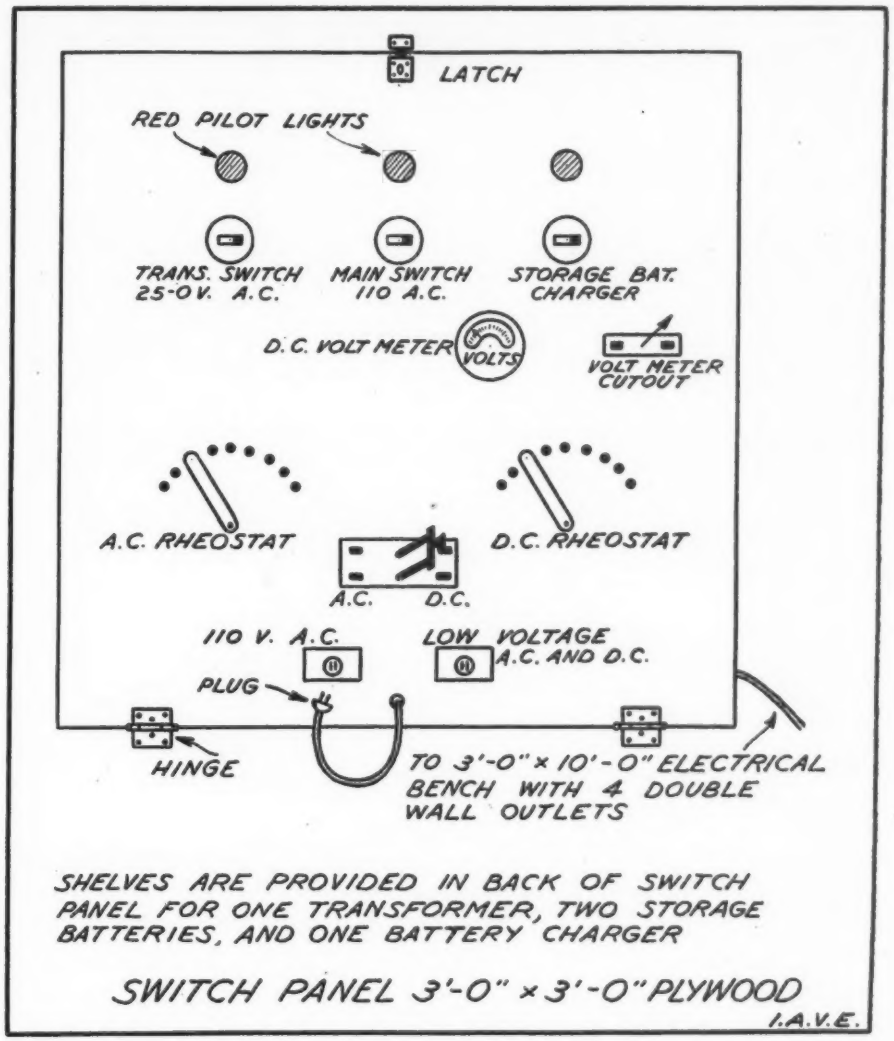
When the instructor is satisfied that the boy knows his job, he permits him to proceed.

It has been found that the boys take pride in passing the first test and it is but seldom that a mistake is made in the actual finishing process.

AN INEXPENSIVE LOW-VOLTAGE SWITCHBOARD

William Duke III, High School, Ardsley, New York

Every general shop requires low-voltage currents of both the alternating and direct type. The term *low voltage* usually refers to voltages from 0 to 25. Such current is needed for operating electrical equipment such as bells, motors, magnets, and lights, as well as for experimental and testing work. The common way of obtaining this current is through the use of dry cells, storage batteries, and small transformers. At least that's the common method in small schools where expensive



electrical switchboards and converters are out of the question.

The switchboard described herewith was made in the author's high-school classes. It is a professional-looking job, too, with pilot lights, brass switches, and terminals as well as rheostats and voltmeters.

It would be difficult to compute the actual cost of this board, because many of the parts were made from junk or were second-hand. It has been found very useful and serves its purpose well.

MANIPULATIVE MECHANICAL-DRAWING TESTS

B. J. Stern, Industrial High School, New York City

Among the first-termers in my related-mechanical-drawing classes, I often find boys who are rather vague about reading an ordinary linear scale, to 16ths of an inch. It is essential, of course, that this weakness be corrected right at the start. To aid me in quickly detecting and correcting these measuring handicaps, I have developed the manipulative device shown in Figure 1.

The device consists of a plywood base, upon which have been firmly glued three standard 12-in. rulers graduated to 16ths of an inch. Parallel to these are affixed three wooden rails with cross sections like the male member of a dovetail joint. Upon these rails are fitted a number of sheet-metal pointers which slide easily, being prevented from coming off by the shape of the rail.

Each beginner is tested by means of this device at the beginning of the term. A few of the advanced students are permitted to assist in administering the test. In use, the newcomer is handed a piece of paper containing a number of measurements. He is then required to set the pointers on the rail opposite the corresponding points on the rulers within a specified time. In this way, all the measuring weaknesses in the first-term classes are detected in a short while, and corrective exercises can be instituted at once. For this purpose, the testing device can be used also as a teaching aid.

Figure 2 shows another test which is intended to aid in finding nomenclature difficulties. As shown, a three-view working drawing of a cast-iron tee is mounted on a plywood base. A quarter section is included in the front view. Numbers from one to ten are scattered over the drawing, each one referring to a specific line, dimension, or other part of the drawing. For example, the number 3 marks

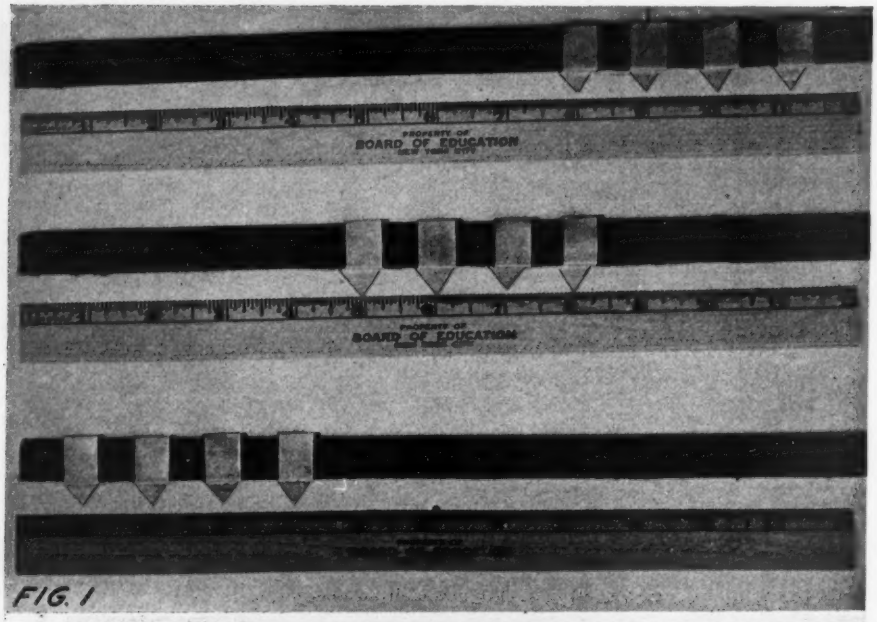


FIG. 1

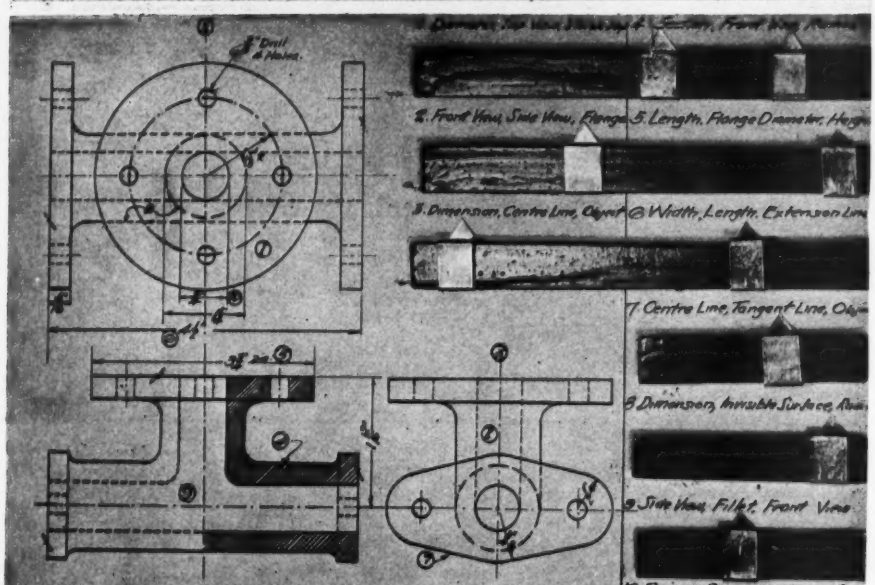

Drill
4 Holes
2. Front View, Side View, Flange
5. Length, Flange Diameter, Height
3. Dimension, Centre Line, Object
6. Width, Length, Extension Line
7. Centre Line, Tangent Line, Object
8. Dimension, Invisible Surface, Rivet
9. Side View, Fillet, Front View
10. Radius, Diameter, Circumference

FIG. 2

the center line of the top and side views. On the right-hand side of the base are mounted rails opposite a series of numbers corresponding to the ones in the drawing. Each of these numbers has next to it three names common to mechanical drawing, one of which is the correct one for that particular number. Thus, the student faces a multiple choice when setting the pointer on the rail. A study of Figure 2 will make this clear.

These are but two of a number of manipulative tests that are used by our drawing classes. They have been found most useful. They seem like a game to the boys, thereby removing the usual strained atmosphere common to examinations. They set up no psychological barriers, and the student's mind is free to function with no inhibitions of fear or strain. No elaborate preparations are needed to give the tests and no extensive bookkeeping is needed. The tests are entirely individual and take but a short time to administer. With the help of some advanced students, the specific weaknesses in a group of beginners can be quickly determined.

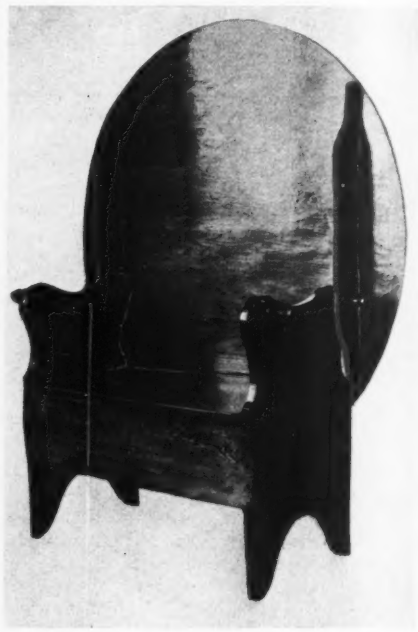
A SETTLE TABLE

Ralph M. Merry, High School, Malden, Massachusetts

Little need be said of the settle table except that it has many uses in the home, on the lawn or at camp. There is a very convenient storage compartment under the lift-up seat and the top can be removed from the base by taking out four pivot pins. Thus it can be very conveniently stored away when not in use. This settle can be made in two sizes with a 42-in. top or a 48-in. top. The length of the base must be cut down for the 42-in. top. This settle can also be made with a rectangular top if desired.

Material Needed:

White pine, oak, or white wood may be used. A white pine base for lightness and an oak top for durability is the best combination. The two ends require two pieces of wood 13/16 by 16¼ by 27 in. The two sides of the storage compartment need pieces 13/16 by 8½ by 33⅝ in. The bottom of the compartment is made of ⅜-in. plywood, 15⅜ by 31¾ in. The lift-up seat consists of two parts, the back piece which is stationary is ¾ by 4 by 31 in., and the lift-up seat or cover is ¾ by 12¾ by 29 in. This allows for the tongue-and-groove construction. Two end cleats ¾ by 1¼ by 12¾ in. are needed for reinforcing



Settle table

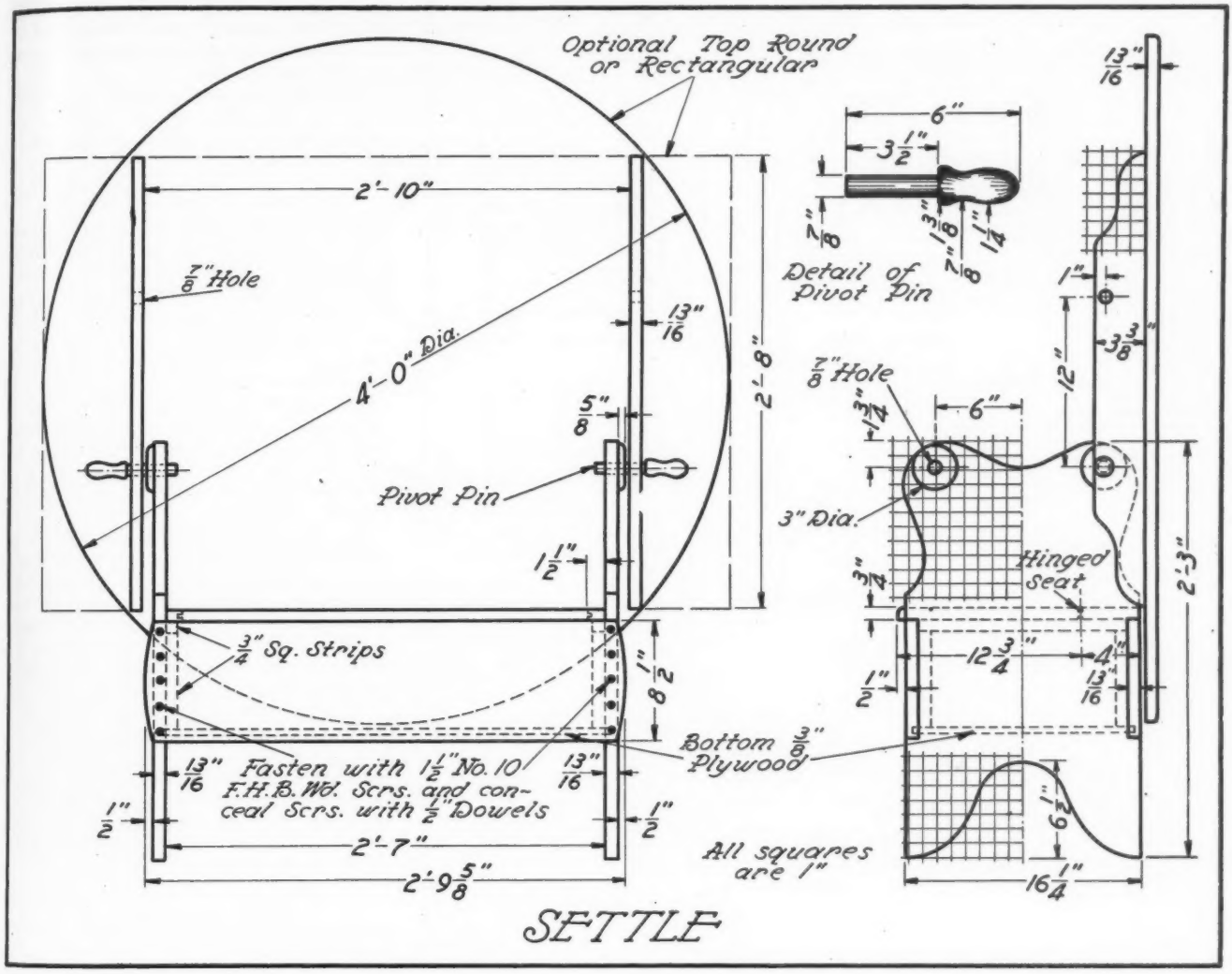
the cover, and four hardwood disks for reinforcing the pivot-pin holes. These disks should be ⅝ in. thick and 3 in. in diameter with a ⅞-in. hole in the middle. They, and the pivot pins, are turned out on the lathe. The four pivot pins are 1⅜ in. in diameter and 6 in. long. The table-top braces or supports are 13/16 by 3⅜ by 32 in. The table top itself is 13/16 in. thick and 48 in. in diameter.

Directions for Making:

Glue and square up the stock for the ends. Lay out the pattern for the design on one of the ends, then tack the two ends together and cut out on the band saw, following the lines carefully leaving half the line visible. After the ends are sawed out finish up the edges and sandpaper smooth.

Next, square up the two sides of the storage compartment, and cut out the round ends on the band saw. Cut a ⅜-in. rabbet, ⅜ in. deep all the way around the lower inside of the ends and the sides. This is to receive the ⅜-in. plywood for the bottom of the compartment.

Insert the ⅜-in. plywood into the grooves and screw and glue the sides and ends with No. 10 by 1½-in. f. h. b. wood screws. The heads should come about ⅜ in. below the surface. The holes should then be plugged and



3/8-in. dowels glued into place. This will give the beautiful peg effect.

Screw and glue a 3/4-in. square strip on the inside of each end to support the seat cover, and also glue and brad corner strips in the inside running up and down to support the base. Square up the stationary back piece to which the cover is hinged, and glue, screw, and peg it in place.

Next, the seat is made and attached to the stationary back piece with hinges.

The hardwood disks are next glued and screwed in their proper places.

The table top is made of 7/8-in. boards 6 in. wide, doweled and glued. Use precautions when doweling so as to prevent any dowels from showing on the edge after the top has been sawed to a circle 48 in. in diameter. After the top has been glued up plane the better surface level and smooth, then it is cut to 48 in. in diameter on the band saw. Finish up the edges, rounding the top edge a little and smooth with sandpaper. Square up the two cleats that go under the top, locate and bore the two 7/8-in. holes on the cleats, and cut the ends to the design shown. Glue and screw the cleats to the underside of the top. Sink the screw heads 3/8 in. below the surface of the top. Plug these holes after the cleats are fastened to the top with 3/8-in. dowels.

The finish is left to the individual taste. If the settle is made with a white-pine base and an oak top, burnt umber thinned out with turpentine and linseed oil makes a beautiful stain. Then treat with white shellac and Valspar varnish rubbed well between coats.

AN A.C.-D.C. RADIO RECEIVER

Gilbert Oberweiser, Milwaukee, Wisconsin

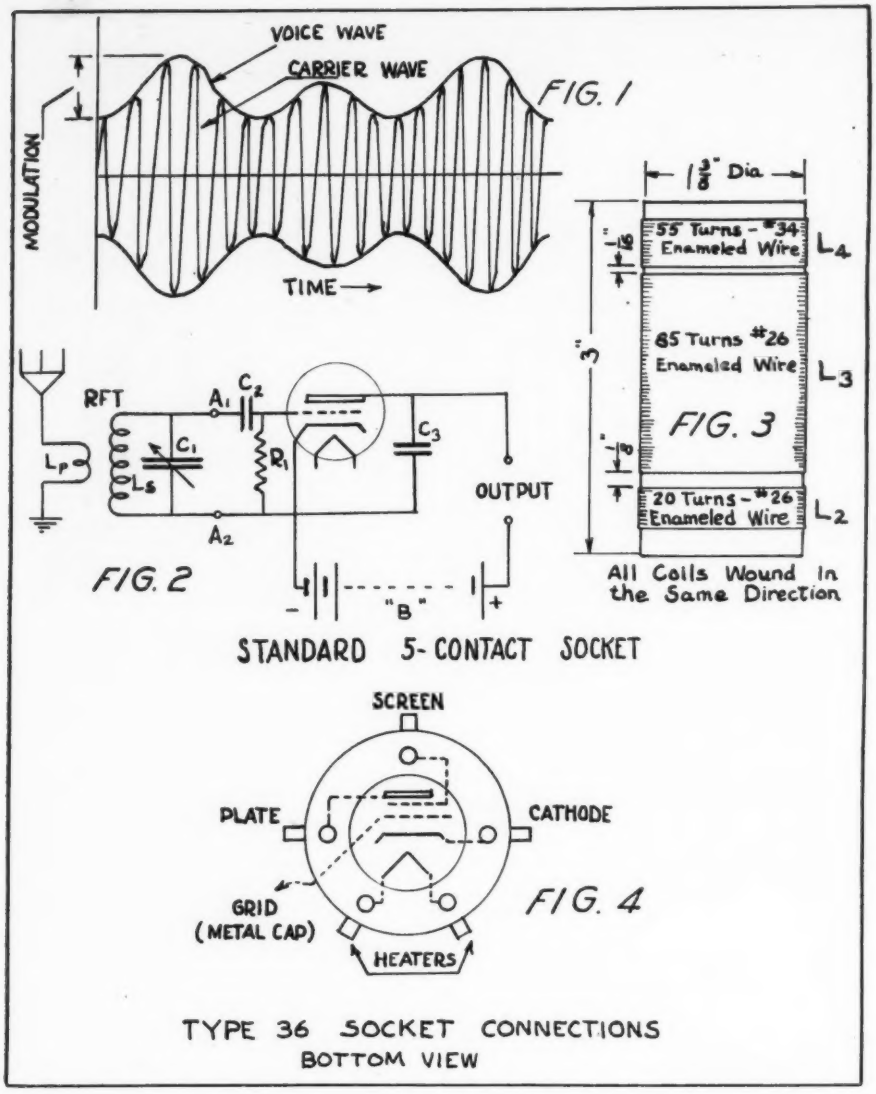
In the articles on page 382, of the December, 1936, and page 132, of the April, 1937, issues of this magazine, the power supply and the amplifier were discussed. Now, the tuning and detector circuit will be considered. This is that part of the receiver which first "picks up" the radio signals, tunes itself to the desired one, and rectifies the signal in such a manner that the voice or music from the transmitting station can be heard and amplified.

Theory of Operation

Before tracing the impressed signal through the circuit, it might be advisable to consider briefly the electrical components that make up this broadcast signal, which is shown graphically in Figure 1. As can be seen, this signal is made up of two components, the carrier wave and the voice wave, the carrier wave being of the high frequency at which the transmitter is operating, and the voice wave being the frequency of the voice or music. At the transmitting station, the voice wave is superimposed upon the carrier wave which causes the carrier wave to be modulated as shown in Figure 1. Electrical energy of high frequency is used because it can be transmitted much more readily through space than can energy of lower frequencies. The carrier, then, just as the name implies, "carries" the voice frequencies.

Now consider the voltage wave, shown in Figure 1, impressed across the antenna and ground of the receiving circuit shown in Figure 2, which is equivalent to its being impressed across the coil L_p.

L_p and L_s, being respectively the primary and secondary of a radio frequency transformer, are magnetically coupled to each other so that a higher voltage will be induced in the secondary (L_s) than was impressed across the primary, the ratio of voltages depending upon the ratio of the turns.



If the condenser C_1 is now tuned so that the circuit L_sC_1 is in resonance to the frequency of the carrier (or radio frequency) wave that was impressed, the voltage between points A_1 and A_2 will rapidly increase nearly a hundred times in magnitude. This selectiveness enables receivers to separate broadcasting stations from each other so that no interference will result.

Looking back again, it can be seen that the impressed signal has been stepped up, or amplified, first by virtue of the transformer, then by means of the resonance circuit, and is now ready for rectification so that the voice frequencies may be made audible. To accomplish this end, the detector must separate the audio component from the carrier wave.

In this circuit, Figure 2, detection is brought about by means of the grid leak and condenser, R_1 and C_2. That is, the condenser C_2 offers very little impedance to the high frequency carrier wave, while the resistor R_1 biases the grid so that the tube operates at a point where it draws a small grid current. The fact that this grid current is not a linear function of the grid voltage makes detection possible by this means. The grid current not being a linear function of the grid voltage means that if the grid is excited so that it goes alternately positive and negative in equal amplitudes, the grid current will increase much more during the positive half of the cycle than it will decrease during the negative half.

With this in mind, consider the grid leak and condenser shown in Figure 2 with a modulated signal impressed across points A_1 and A_2. During the positive half of the cycle the grid current will increase greatly, loading the transformer very heavily. This increased load on the transformer will tend to counteract the generated voltage rise, due to the regulation of the transformer. However, during the negative half of the cycle the grid current will decrease, which will lighten the load across the transformer. This lightening of the load will tend to increase the negative swing of the voltage generated in the transformer.

What has really happened then, is the fact that the positive loops of the carrier wave have been attenuated, leaving only the negative half of the carrier wave effectively fluctuating the grid of the tube. This having been done, the audio components of the wave no longer have the canceling effect upon each other, but now fluctuate the grid according to their own frequency, which is amplified in the same manner as was explained in the article on the amplifier.

The radio frequency component is now filtered or by-passed by the condenser C_3 which leaves the voice signal across the output.

Discussion of Detector Circuit

It will be noted that the actual detector circuit used in the receiver is slightly different from that used for the purpose of explanation. The two circuits are principally the same, however, except that the one actually used in the receiver incorporates a controlled regenerative system using a three-circuit tuning coil. This feature is important inasmuch as it increases the efficiency of the receiver, but if the receiver is to operate without generating undesirable oscillations, great care must be taken that the circuit specifications are followed and that the circuit is properly adjusted.

The principle involved in regeneration is based on the fact that the coupling between coils L_4 and L_3 is such that energy from the plate circuit is in proper phase with and is fed back to the grid circuit to be amplified again, thus increasing the efficiency of the circuit. If the coupling is too close, though, or if other factors in the circuit are overly favorable for feedback, this process of energy exchange between the grid and plate circuits may build up to a point where sustained oscillations or "squeals" are produced. This point at which the receiver might break into oscillations is also dependent upon the frequency at which the set is operating, unless the condensers C_8 and C_9 are of proper value.

The three-circuit coil is wound on tubing 1 3/16 in. in diameter as shown in Figure 3. All the coils must be wound in the same direction if the connections from them are to be made the same as shown in the diagram. It might be mentioned here that the number 34 wire specified for L_4 can be obtained very inexpensively by purchasing a midget *RF* coil that sells at some places for one cent. There is more than enough wire on one of these to wind L_4. The three-circuit coil may be mounted on the chassis by means of a small bracket so that there is a space of about ½ in. between the chassis and the end of the coil. A plug-in type of coil may be convenient, inasmuch as all the connections to the coil can be made without the coil being in the way.

If for any reason the specified tubing is not available, or if a different capacity tuning condenser other than specified is used, the number of turns on each coil must be changed accordingly. The relation of the number of turns wound on coil L_3, for different coil diameters, to its tuning condenser (C_{12}) may be found by calculating the proper *LC* value that will cover the broadcast band. After this is done, the number of turns may be calculated by substituting *L* (from the *LC* product) into any reliable inductance formula. An *LC* table and an inductance formula can be found by referring to a physics and chemistry handbook. If the number of turns on coil L_3 is changed an appreciable amount, the turns on

WIRING DIAGRAM OF COMPLETE RECEIVER

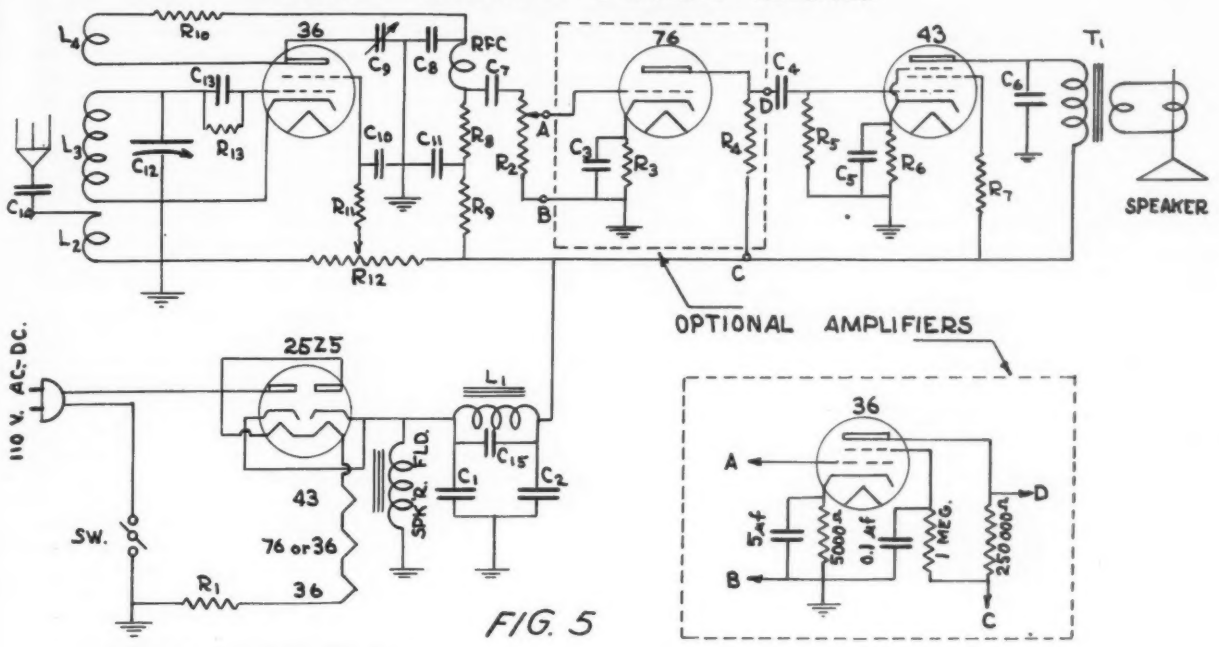
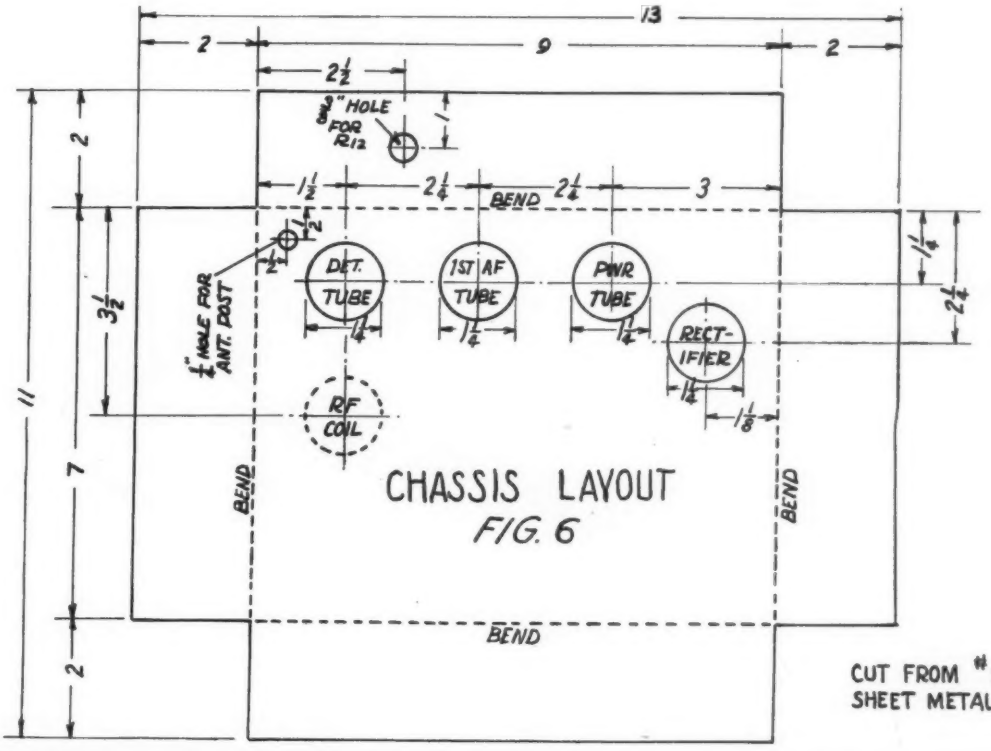


FIG. 5

CAUTION ! DO NOT USE ANY EXTERNAL GROUND CONNECTION

R_1 = 200Ω ; 20 W.
R_2 = 1 MEG VOL. CONTROL
R_3 = 5000Ω ; ¼ W.
R_4 = 100000Ω "
R_5, R_8, R_9, R_{11} = 500000Ω ; ¼ W.
R_6 = 600Ω ; 1 W.
R_7 = 2000Ω ; ¼ W.
R_{10} = 1250 Ω "
R_{12} = 50000Ω POTENTIOMETER
R_{13} = 2 MEG.
C_1 - C_2 = 16-12 μf ; 200 V.
C_{15} = 0.25 μf
C_3 = 5 μf ; 25 V.
C_4, C_7, C_{10} = 0.1 μf ; 125 V.
C_5 = 10 μf ; 25 V.
C_6, C_{14} = .001 μf
C_8 = .0001 μf
C_9 = 30-160 μμf
C_{11} = 1 μf ; 125 V.
C_{12} = .0005 μf TUNING COND.
C_{13} = .00025 μf
L_2-L_3-L_4 = RF TUNER
L_1 = 30 H. AF CHOKE
RFC = 80 MH. RF. CHOKE
T_1 = OUTPUT TRANS.



CHASSIS LAYOUT

FIG. 6

CUT FROM #12 SHEET METAL

L_2 and L_4 should be increased or decreased proportionally.

The condenser C_9 (see Fig. 5) is of the small trimmer type. Its function is that of bringing the maximum feed-back point to the middle of the broadcast band so that the regeneration system will have miminum frequency characteristics. The regeneration control (R) determines the magnitude of feed-back. Both C_9 and R_{12} are mounted in back on the chassis, and are adjusted for the best results before the set is put into final operating condition. The value of R_{10} is critical. If R_{10} is too low, the regenerative system will have poor frequency characteristics, and if it is too high, all regenerative effects of the system will be lost.

C_{11} and R_9 make up the audio filter necessary to isolate the detector from the high-gain audio stages that follow. Without this, undesirable audio howls will result.

Construction Notes

A plan for layout on a 2 by 7 by 9 in. metal chassis is shown in Figure 6. It will be noticed that mounting dimensions for some of the parts have not been included in the drawing. This is due to the fact that the sizes and shapes of these parts vary, depending upon the make of the parts. The mounting of the parts that will be brought through the front of the cabinet (tuning condenser, volume control, switch, and speaker) has been left to the discretion of the builder so that the arrangement would be flexible enough to fit any cabinet that may be available.

It is recommended that the speaker be mounted on baffle board, as the improvement in tone quality is much worth the while. A convenient way to do this is to obtain a piece of ¼-in. softwood veneer, the length being about as long as the chassis, and the height about 8 or 9 in. The baffle is then fastened to the front side of the chassis, so that it stands vertical. The shafts of the tuning condenser, volume control, and switch may then be mounted through the baffle if desired.

Careful wiring of the receiver is extremely important, especially if the 36 type of tube (see Fig. 4) is used in the first audio stage. All leads should be made as short as possible. The grid and plate leads should be kept as far apart as possible. Great precaution should be taken so that none of the leads of the last audio stage, or even the first audio stage, are run in close proximity to any of the detector leads. In other words, the detector wiring should be kept apart from that of the amplifier.

The 36 detector tube is, of course, shielded. And if a 36 is used in the first audio stage, this also should be shielded. The grid leads of all three tubes should be wired with shielded wire, the shields being grounded to the frame. If a 36 is used as first audio amplifier, it may even be necessary to shield other leads in order to prevent audio howling.

The choice between using the 76 triod or the 36 screen-grid tube for the first stage of audio amplification is a matter of price versus performance. Because of the small difference in cost, it may pay to use the 36 type tube. However, when using the 36, much greater care in construction, paying special attention to the precautions listed above, must be taken if the receiver is to operate properly at all. If the 76 type tube is used, condenser C_{15} (see diagram Figure 5) may be omitted.

The cost of the complete receiver, using the 76 as first audio amplifier is estimated to fall somewhere between $7 and $12, and using the 36 as first audio amplifier the cost will be about $1 more.

An ordinary antenna may be used with this receiver. Of course, the better the antenna, the better the reception. As warned against before, *no external ground* should be used, as one side of the power line, which is connected directly to the set, is already grounded. All grounds indicated in the diagram of connections are made to the metal chassis.

If the receiver is operated very near a broadcasting station, a wave trap, inserted in the antenna circuit, may be necessary to prevent that station from interfering with other stations. Wave traps can either be bought on the market or made from a coil and condenser.

(To be continued)

A FIRM SUPPORT FOR SCROLLING METAL IN A VISE

Jos. J. Lukowitz, Milwaukee, Wisconsin

Pieces of pipe are often used by the metal-worker to aid in the shaping of metal. When the pipe is held in the vise in the ordinary way, it has the annoying tendency to slip down under the blows of the hammer. This slipping can be entirely overcome by cutting notches at each end of the pipe as shown in Figure 1.

When such a notched piece of pipe is used, it is practically as solid as the horn of an anvil.

A MODERNISTIC SERVING TRAY

J. I. Sowers, Miami, Florida

It is difficult to design a serving tray that is interesting, usable, modern, and yet within the ability of the grade student who is to find satisfaction in the project. The tray illustrated in Figures 1 and 2 is a modern streamlined-type tray design, consisting of only five parts — handles, side rails, and bottom. Aside from requiring only a modest degree of skill, it has most pleasing lines.

The bottom may be made on one plain ⅜ by 9 by 15⅝ in. piece of stock, or it can be elaborated upon as is shown in Figure 3. At *A* in Figure 3 is shown a bottom built up of contrasting colored woods. The one shown at *B* is inlaid, while most difficult of all, the one at *C* is made up of tangential sections.

The method used in making the tangential sections is further illustrated in Figure 4. At *A* in Figure 4, is shown the layout across the stock on a 45-deg. angle. If the stock is not wide enough to permit this, it is built up to the required size. The sections are then sawed apart on the centers, as shown, into sections 1, 2, 3, 4. Sections 1 and 2 are used in the position shown, 3 and 4 are turned over. In this way, all the grain lines are made to center as shown at *C* in Figure 3. The method of gluing these sections together by the use of a feather is shown at *B* in Figure 4. After these are glued and set, a similar feather is cut in and glued about the outer edge as shown at *C*, Figure 4. This method is very useful in making small doors for modern-type cabinets. Of course when a tangential bottom is made, it must be made from a wood having a prominent grain, as for instance, plain sawed red oak, or highly figured gum.

(Continued on page 12A)

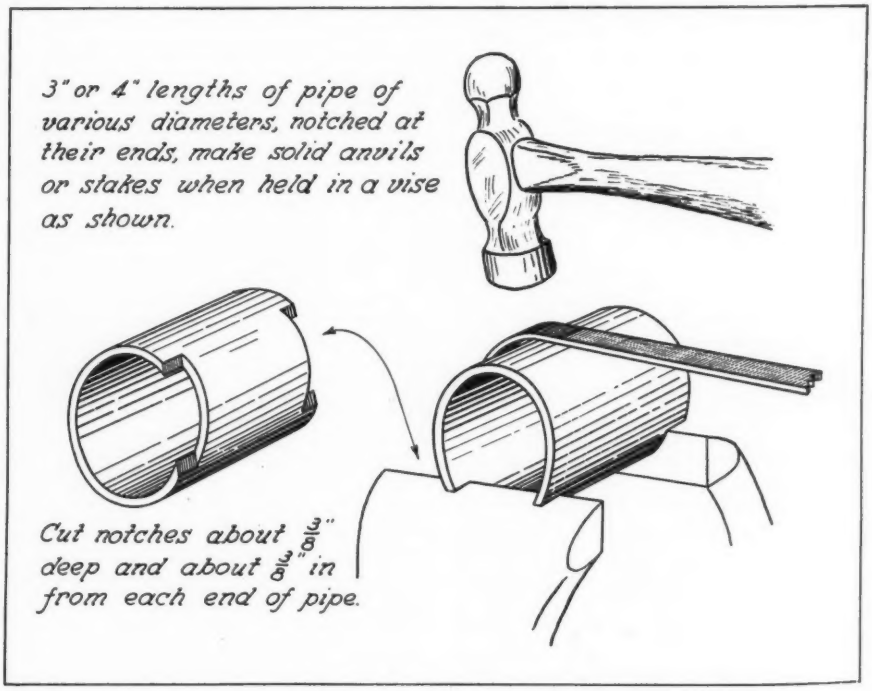

3" or 4" lengths of pipe of various diameters, notched at their ends, make solid anvils or stakes when held in a vise as shown.
Cut notches about 3/8" deep and about 3/8" in from each end of pipe.

Fig. 1. A firm support for shaping metal in a vise

A MODERNISTIC TRAY

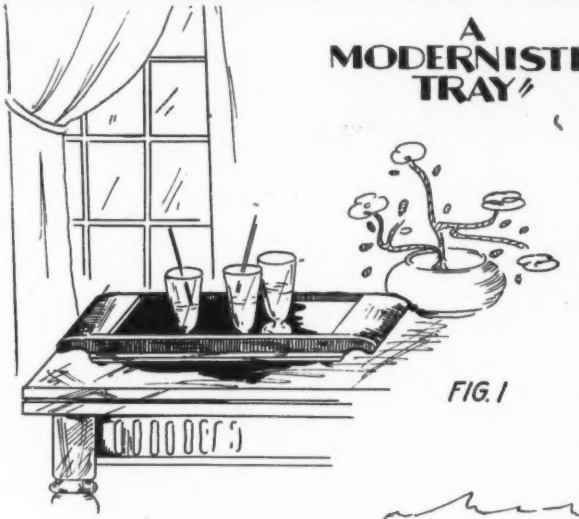


FIG. 1

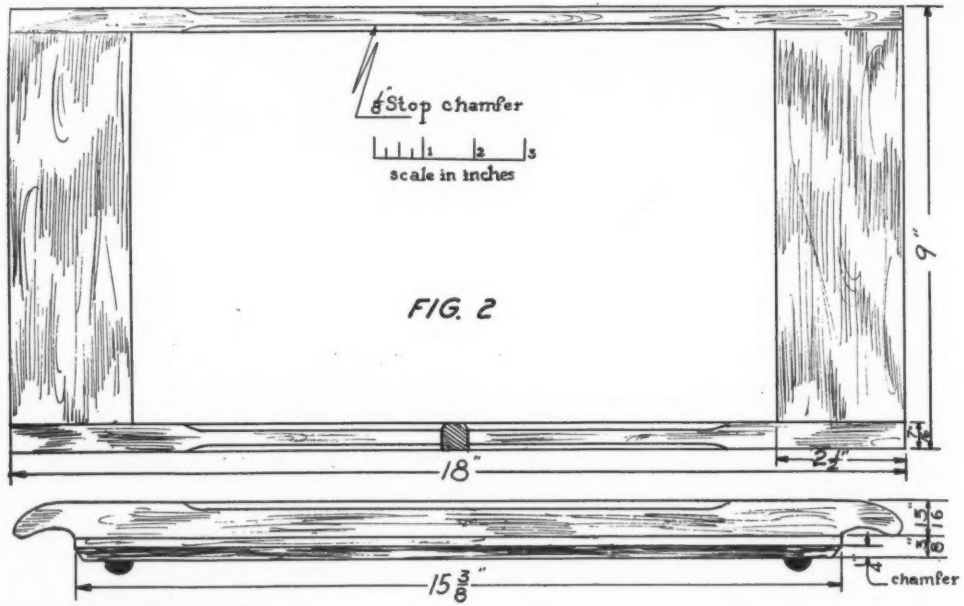
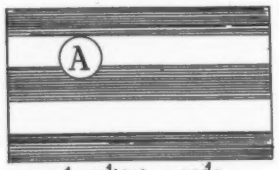
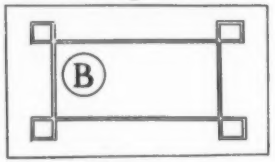


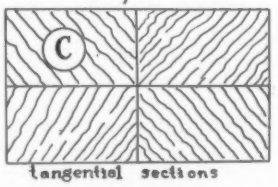
FIG. 2



contrasting woods



Inlay



tangential sections

Bottom of tray may be made decorative as shown

FIG. 3

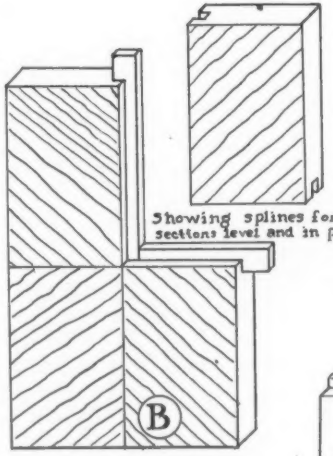
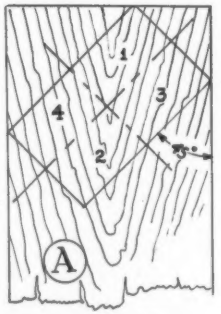
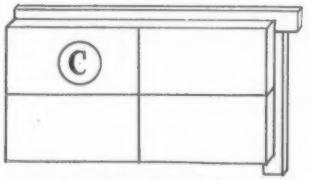


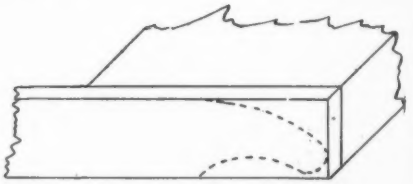
FIG. 4



Lay-out method for tangential sections



Splines also used about outer edges



Showing side rail glued to end ready for shaping

FIG. 5

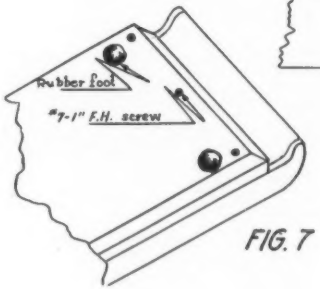


FIG. 7

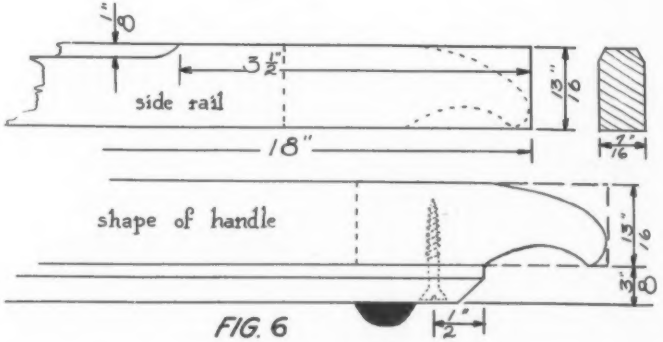
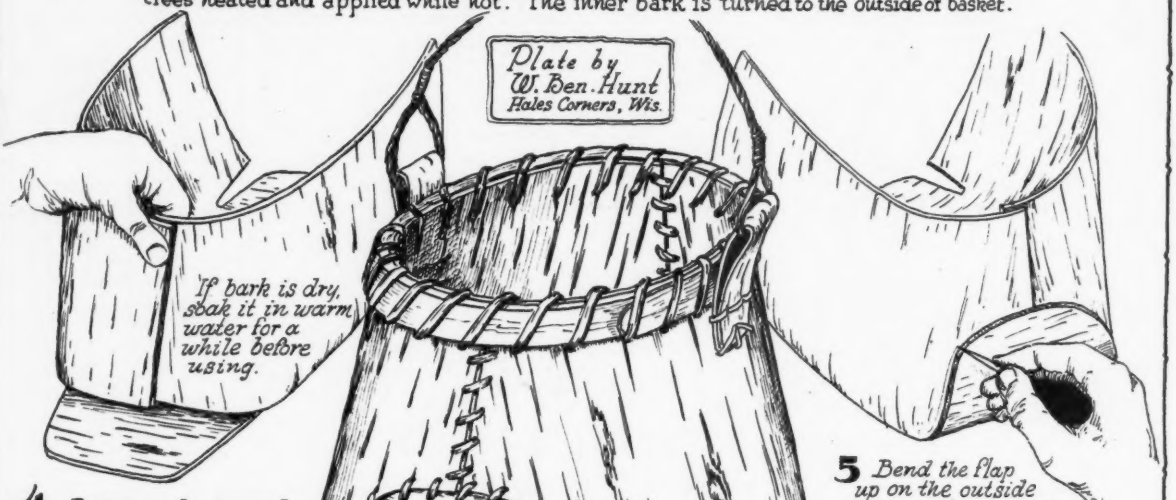


FIG. 6

BIRCH-BARK BASKET

Baskets like these are used by the Indians for carrying and storing purposes. When used for water or maple sap, the seams are smeared with pitch from pine trees heated and applied while hot. The inner bark is turned to the outside of basket.

Plate by W. Ben. Hunt Hales Corners, Wis.



4 *Bring ends around and hold then together as shown above.*

The size of the basket depends on the size of the sheet of bark. Finished baskets are round or oval at the top and square or oblong at the bottom.

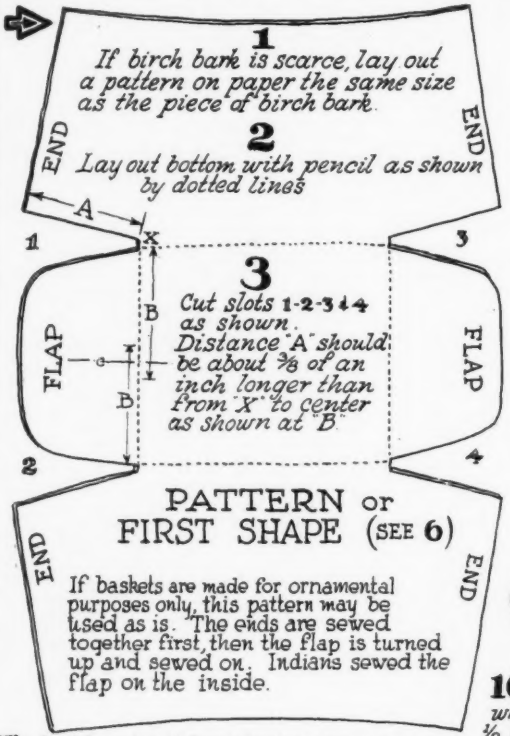
5 *Bend the flap up on the outside and scratch or mark around it.*

6 *Cut away the section as shown below.*

ONE END FINISHED for SEWING

1 *If birch bark is scarce, lay out a pattern on paper the same size as the piece of birch bark.*

2 *Lay out bottom with pencil as shown by dotted lines*



3 *Cut slots 1-2-3-4 as shown. Distance "A" should be about ⅜ of an inch longer than from "X" to center as shown at "B"*

PATTERN or FIRST SHAPE (SEE 6)

If baskets are made for ornamental purposes only, this pattern may be used as is. The ends are sewed together first, then the flap is turned up and sewed on. Indians sewed the flap on the inside.

The best time to get birch bark is in spring or early summer & it should be use while it is still fresh.

7 *Turn up flap "A" and bend the ends around and over it. Sew seam "B" first and then sew around flap as shown at center top.*

8 *Sew with inner basswood bark which should first be well dried and then soaked in water before using, or use wet raffia.*

9 *After both ends are sewed, level off the top edge with a sharp knife or shears.*

10 *The top rim band is then whittled out of some green wood ½ to 1 inch wide and from ⅛ to ⅛ inch thick.*

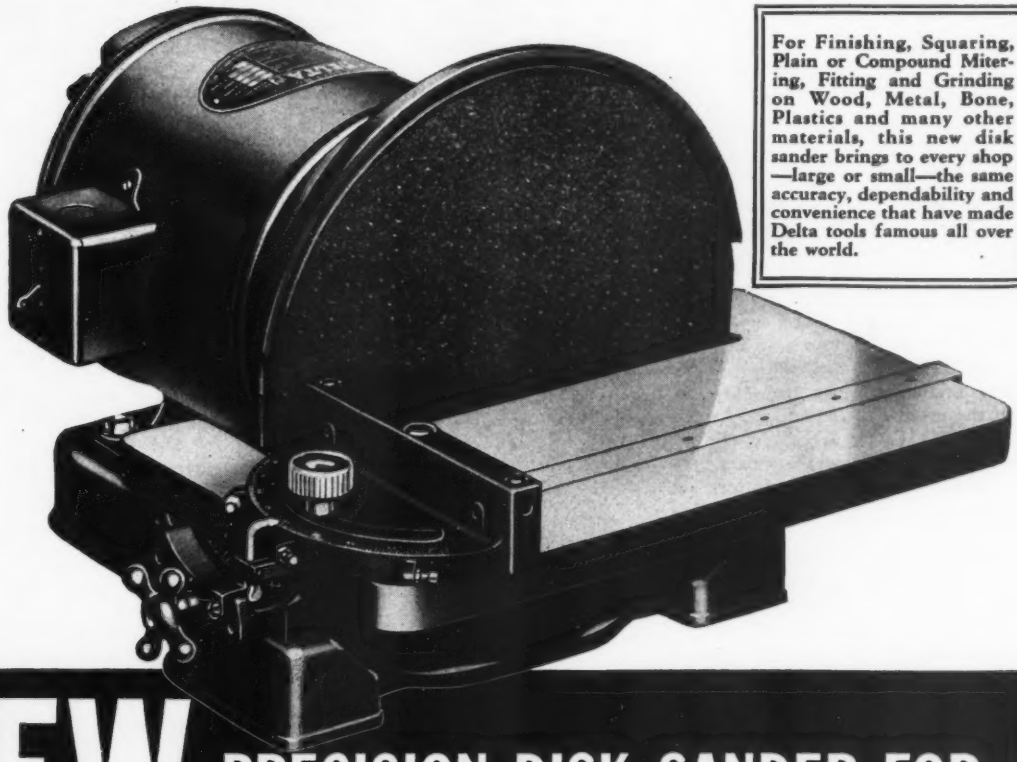
11 *Sew it to the outside of the bark as shown in the upper center drawing.*

12 *Cut two loops of birch bark and sew them on as shown at upper center.*

13 *Make bale or handle of rope of twisted basswood bark or raffia as the case may be.*

14 *Seams and cracks may be sealed with pine pitch which should be heated in a small can, and applied to seams while hot. Large cracks should be sewed up before pitch is applied.*

Baskets for berry picking should not be pitched.



For Finishing, Squaring, Plain or Compound Mitering, Fitting and Grinding on Wood, Metal, Bone, Plastics and many other materials, this new disk sander brings to every shop —large or small—the same accuracy, dependability and convenience that have made Delta tools famous all over the world.

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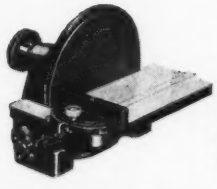
SPECIFICATIONS

12" disks, flat and true-running, for accurate work to outline. Specially machined to insure proper adhesion of abrasive disks.

Table measures 9¾"x16¼". Polished surface with ⅜"x¾" slot for Auto-set miter gauge. Table tilts 45 degrees, and is carried on rigid, well-designed trunnions, with large, convenient clamp knobs. Tilt scale on front trunnion, with adjustable pointer. Husky shaft for belt-drive machine carried on self-sealed bearings. No lubrication required for life of bearings. Sawdust blower available, making machine adaptable for locations where usual disk-sander dust is objectionable.

The skill and ingenuity of Delta engineers is exemplified in this new 12" Disk Sander which is featured in the new 1938 line of Delta motor-driven tools. Not merely another sander, this quality tool is designed to meet every requirement for ACCURATE convenient sanding. From its specially machined, true-running 12" disk to its unusually large tilting table, its husky spindle carried on self-sealed ball bearings, this latest Delta tool is built for long life, low power consumption, accurate dependable results and maximum convenience in operation. Available in two models: Direct-drive, using the Delta ½ h.p. motor with disk fitted directly onto the motor shaft; Belt-drive, for those who wish to use their own motors. The full story of this unusual tool, together with detailed specifications and prices, is found in the new Delta 1938 Catalog. Send for it today!



Belt drive model of new 12" Disk Sander—for use in districts where odd frequency or odd voltage motors must be used. Also permits speed to be suited to individual sanding and grinding requirements.

NEW 1938 DELTA TOOLS

Numerous improvements, new features, refinements, new accessories and new tools are found listed in the latest 1938 Delta Catalog which is just off the press. The new Delta metal-cutting Band Saw, the new Shaper Cutters, the various models of the 17" and 14" Drill Presses, are but high-spots of a complete line of quality, precision tools of vital interest to every craftsman. The scope of Delta tools has widened from the smallest home workshop to the largest industrial plants in the world. Delta tools have aided in the new industrial revolution. Get the full, fascinating story in the latest issue of the Delta Catalog. Send the coupon below for your copy—TODAY!

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(Continued from page 352)

The side rails, for contrast, may then be made and finished in mahogany. So little stock is used in these rails and ends that a rare, or more expensive wood may be used.

Procedure

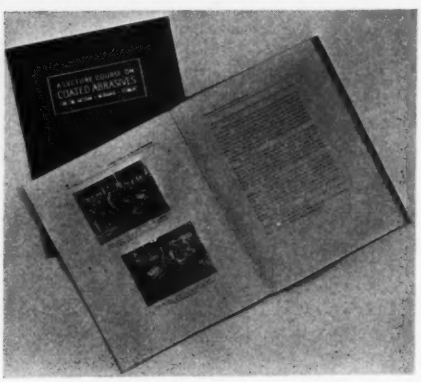
1. Work out the ends 13/16 by 2 by 8⅛ in.
2. Square up side rails 7/16 by 13/16 by 18 in.
3. Glue side rails and ends together as shown in Figure 5. When gluing, hold these parts firmly and accurately in position, and clamp with bar clamps.
4. Lay out end shapes as shown in Figure 6.
5. Shape ends with plane, and gouge, sand to a fine smooth surface. Shaper may be used if one is available.
6. Work up bottom to ⅜ by 9 by 15⅜ in.
7. Fasten the bottom to the end rails with screws as shown in Figure 7. Use No. 7 by 1 in. f. h. screws which are countersunk flush.
8. Four rubber tacks are used for feet as shown in Figure 7.

No matter in what style the bottom is made, finish rails and ends in contrasting woods or stains. For an easier job, the bottom may be painted with Chinese red enamel before being attached. Finish with either French polish, or a rubbed varnish.

This tray may be taken up as a class project, as it affords enough variations in difficulty to meet the requirements of the different degrees of skill represented in the class.

LECTURE COURSE ON COATED ABRASIVES

The Behr-Manning Corporation (Division of Norton Company), Troy, New York, with the aid and counsel of some of the country's foremost educators in the fields of industrial arts and vocational education, has prepared a very complete lecture course on coated abrasives (sandpapers). Practically every student at one time or another, either at school or at home, will use abrasive paper or cloth. Later they may become working tools in his life's occupation. The interest in an authoritative statement on the nature and method of manufacture of this so frequently used, yet so little understood aid to the artisan in the many divisions of industry, is, or ought, therefore, to be, universal.

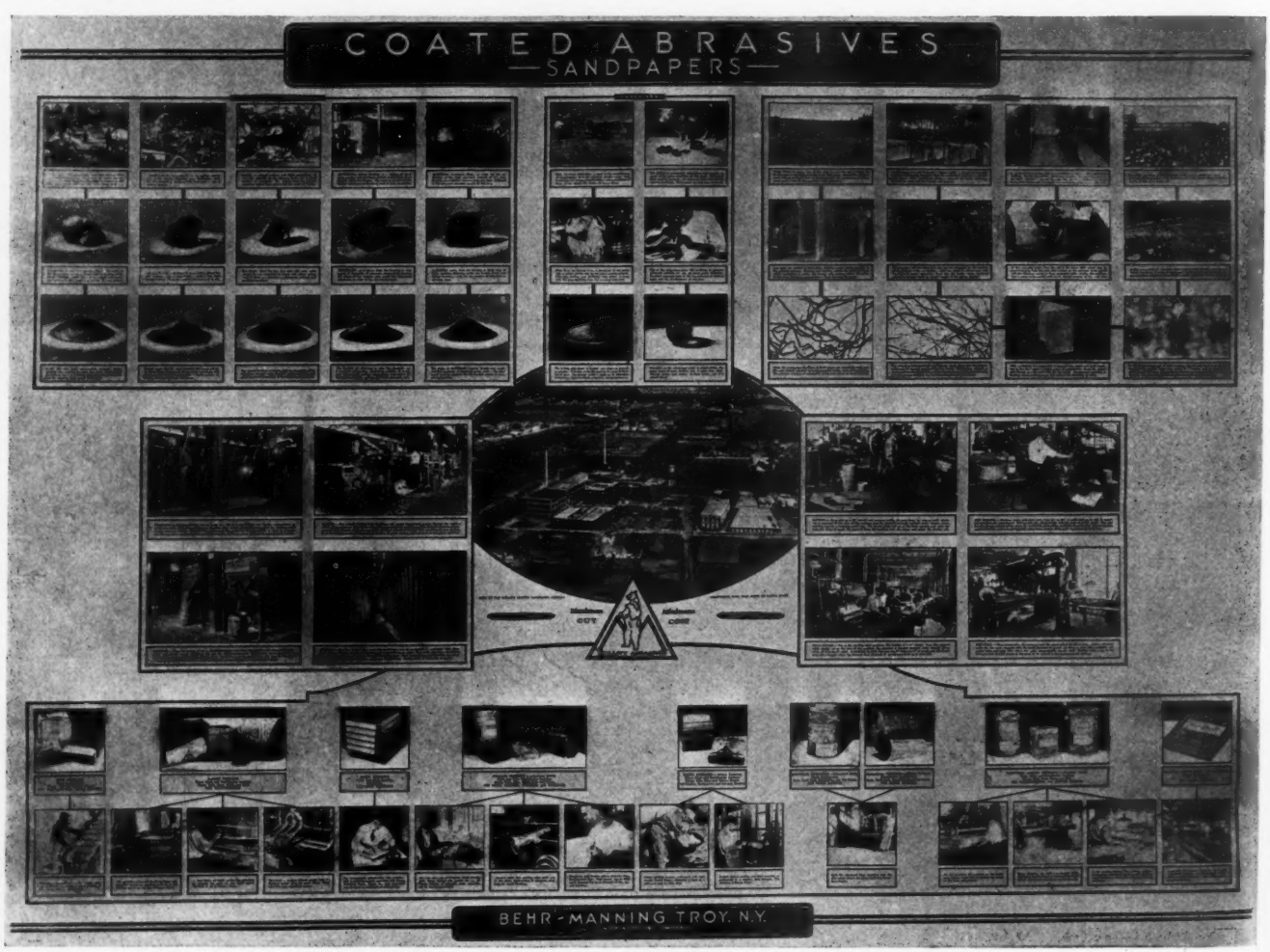


Book containing the lectures

The lecture course consists of: (1) A book of sixty-eight 8½ by 11-inch pages of easily read descriptive material, with 47 reproductions of photos, many of half-page size; (2) a 46 by 36-inch wall chart illustrated with 66 colored photographs; (3) a box of samples containing 6 small vials of the crushed and graded materials required in the manufacture of abrasive papers and cloths.

The lecture gives a very comprehensive overview of the subject matter. How thoroughly the field is covered is shown by a glance at the contents of the course which consists of: (1) Historical notes; (2) abrasives, both the natural and artificial; (3) backings: paper, cloth, and combination; (4) adhesives: glues and synthetic resins; (5) manufacturing processes: preparing the abrasive, the cloth, the glue, manufacturing meth-

(Continued on page 16A)



The wall chart in natural colors

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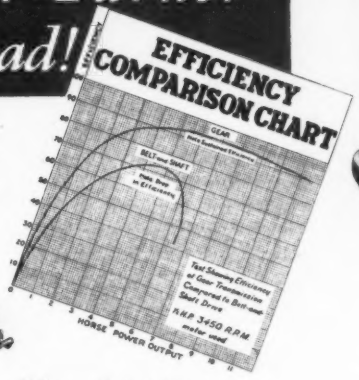

Efficiency Chart shows results of actual comparative tests with same motor on belt drive and new Direct Gear Drive.

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The new TA1162 10″ Tilting Arbor Saw combines the convenience of a tilting arbor with the efficiency—never before approached—of the Direct Gear Drive. Motor actually develops 2½ times its rated h.p. for peak load intervals! Full 3″ depth of cut. Big table (36″ x 27″) with plenty of room in front of blade. Micrometer controls. Fully guarded. Priced only $151.75 with full 1 h.p. motor unit (110-220 v. A.C.) stand, guard, splitter, and kick-back pawls. (8″ model with ½ h.p. motor, $105.05 complete.)

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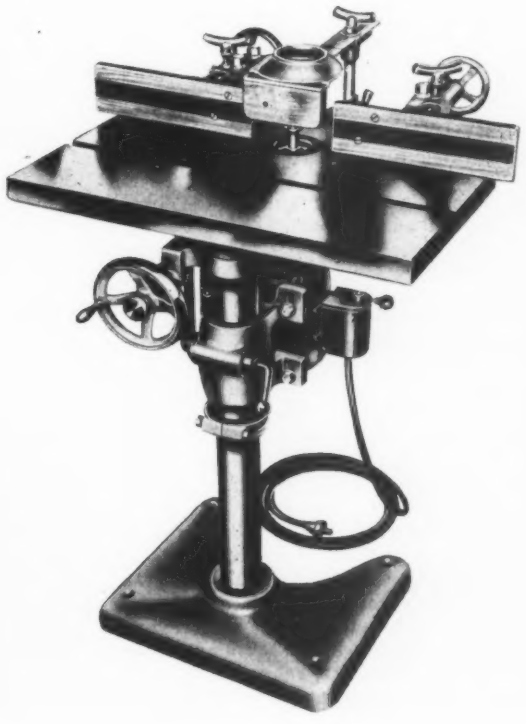

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(Continued from page 12A)

ods, and types of coating; (6) finishing operation: how the various forms in which coated abrasives appear are produced; (7) uses of coated abrasives in the woodworking, metalworking, metal finishing, and miscellaneous industries; (8) directions to the buyer of abrasives, and a table of comparative grit sizes.

The wall chart, with its illustrations, shows in natural colors, how the raw materials used in the manufacture of coated abrasives are obtained from countries far and near, how the backings are made, the kinds of adhesives that are used in the manufacture of the different types of coated abrasives, how the abrasives are applied, additional illustrations of use in industry, and the forms in which the product may be obtained on the market.

The box of samples has been prepared in addition to the lectures and the wall chart in order to make the entire course as complete as possible. The samples consist of graded specimens of the five minerals used: flint quartz, garnet, emery, silicon carbide and aluminum oxide, and a sample of the ground hide glue which is used. The sample box also contains a book of 3 by 5-in. pieces of the finished coated material so that the differences in the various methods of coating as well as the kinds and weights of backing may be studied and compared.

Neither the lectures nor the chart can in any way be designated as advertising matter. The various minerals are referred to by their generic names throughout the course, and the trade names used by Behr-Manning and those used by other representative manufacturers are employed indiscriminately when and as needed. The material, therefore, is educational in every way, and the course will be found exceedingly helpful to any teacher looking for related material on the subject of coated abrasives.

The box of samples

The student who takes the course cannot help but be impressed with the ingenuity and study that have been expended upon the subject, and by the romance which surrounds the manufacture of the coated abrasives now employed by the many industries of the world.

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NOTE: The lecture course described in the foregoing is not to be confused with another lecture course put out by Norton Company, Worcester, Mass., about a year ago, entitled: "A Lecture Course on Grinding — Abrasives, Machines, Methods."

Answers to Questions

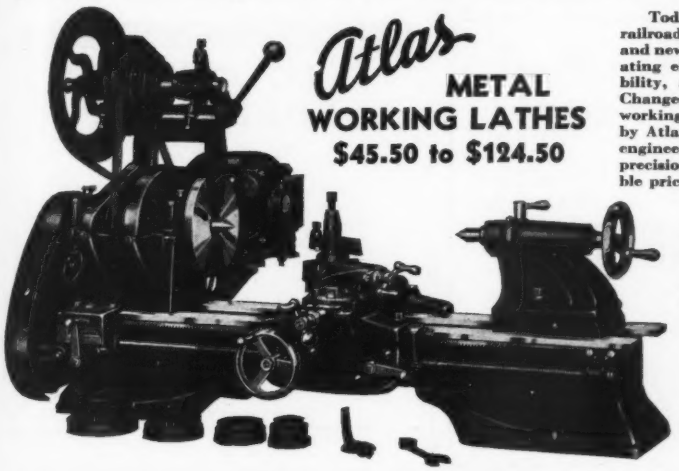
ASH AND HACKBERRY TOOL HANDLES AND BASEBALL BATS

997. Q.: Could you give me any information in regard to ash and hackberry wood? We are going to make baseball bats and all kinds of handles out of the wood mentioned above. We would like to know just how to finish this wood. Any information that you could give me would be highly appreciated. — *B. D.*

A.: You will find that both ash and hackberry are suitable for tool handles and baseball bats if carefully selected for the individual purpose. Both woods will be found to have trees producing hard, close-grained suitable material, and others producing coarser textured material which will prove to be brash and weak. Properly dried, both will be tough, but if the kiln drying is unduly forced, they are as likely to prove unsatisfactory, especially as

(Continued on page 21A)

A Triumph of Modern Engineering



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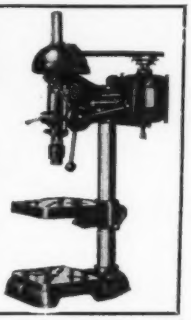

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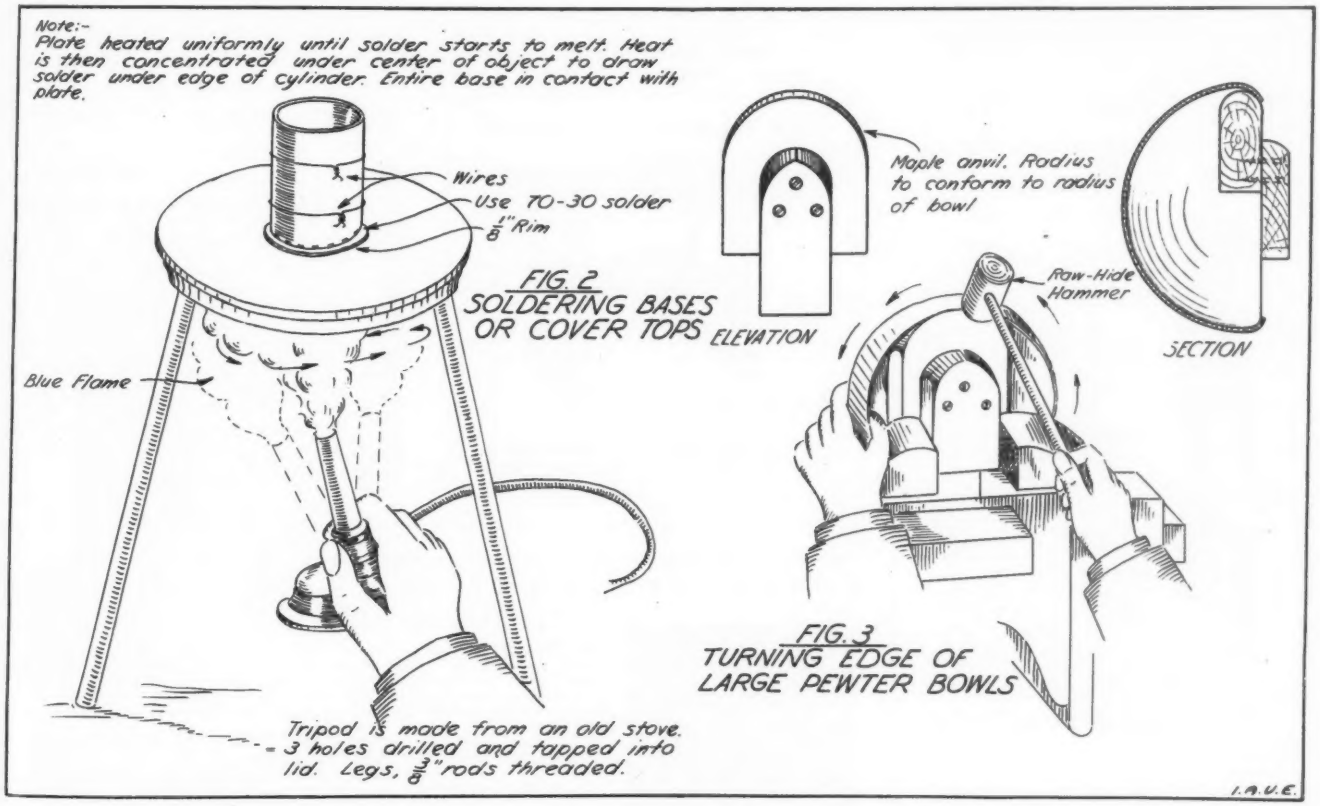
Note:-
Plate heated uniformly until solder starts to melt. Heat is then concentrated under center of object to draw solder under edge of cylinder. Entire base in contact with plate.
Wires
Use 70-30 solder
1" Rim
8
FIG. 2
SOLDERING BASES OR COVER TOPS
Blue Flame
Tripod is made from an old stove. 3 holes drilled and tapped into lid. Legs, 3/8" rods threaded.
Maple anvil. Radius to conform to radius of bowl
ELEVATION
Raw-Hide Hammer
SECTION
FIG. 3
TURNING EDGE OF LARGE PEWTER BOWLS
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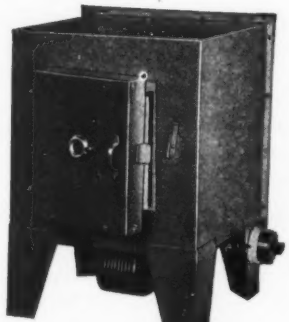

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(Continued from page 16A)

bats. In either case, do not dry below 7 per cent, with a maximum of 10 per cent. Kren, the local bat manufacturer, to whose shop come Babe Ruth and his contemporaries, finds that the specially selected combgrain stocks should be roughed out as squares, cribbed up in a warm, dry loft for six months or more, rough-turned within ¼ in., and then slung in hammocks in a warm loft for another three months or until ready for finish-turning. This is necessary to avoid the inevitable flattening which occurs when bats are finish-turned the first time in the lathe. Commercially the dry kiln will offset some of this time element.

As far as the finish is concerned, perhaps a stain and filler combination, made on a lacquer binder base, will prove the most satisfactory. This can be applied while the bat is in the lathe, the filler applied at 600 r.p.m. and forced into the pores with a rag pad. After a few hours drying, the bat can then be varnished by spray or brush. Generally, one coat will be sufficient. A high-gloss finish is not desirable. If the tool handles are to be made in quantity, then they should be finished by tumbling in a rotating barrel as per directions of the stain manufacturer. — *Ralph G. Waring.*

BLEACHING ACTION OF LACQUER ON SHELLAC

998. Q.: We are experiencing difficulty in applying lacquer over oil stains and fillers. It seems as though the filler bleaches out after a considerable period of time has elapsed since the actual finishing took place. This trouble is not prevalent or general, in fact, I can recall less than a dozen pieces that have been affected.

The steps we follow in finishing are:

1. Fill with paste-wood filler and let stand for 24 hours.
2. Apply oil stain and let dry 24 hours.
3. Brush or spray one coat white shellac, and rub down lightly with fine steel wool.
4. Spray two or three coats of lacquer, rub last coat with felt pad charged with rottenstone, and rubbing oil.
5. Clean up with lacquer polish.

The "bleaching out" does not appear until a period of over a year has elapsed from the time of finishing. This difficulty shows up in the pores of the wood, therefore, I assume that the filler has been affected. Another thing, this trouble does not appear on projects that do not require wood filler even though we use oil stains. I wonder if it is possible that in rubbing down the shellac coat there might be places where the shellac coat has been rubbed through with the result that the lacquer has caused some chemical change or bleaching of the filler? If so, I do not understand why such a long period of time should elapse before the difficulty is apparent. If I am correct, lacquer dries by loss of the thinner which is by evaporation and this process takes at the most but a few hours. — *T. A. T.*

A.: The bleaching action of lacquer over shellac has been known for some time. This is occasioned by the solvents of the lacquer penetrating the thin sizing coat of shellac, becoming absorbed by the filler, and even-

(Continued on page 23A)

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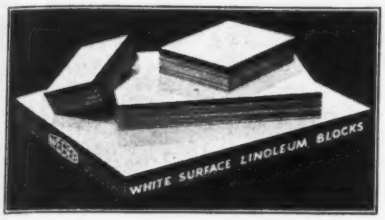

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(Continued from page 21A)

tually, in the presence of light, producing a bleaching action on the color of the filler. This is especially evident if the latter is partially colored with oil-soluble dyes which in their turn are at best only partly lightproof.

In the second phase of this effect of bleaching, there is some evidence that a condition known in the finishing trade as "bridging" may have occurred in part. In this case, the shellac has covered over the pores, the filler has sunk below this covering and the light passing through the finish film is refracted to give a gray cast in the pore.

If you have a copy of *Principles of Mill and Paint Shop Practice* at hand, study the chapter on filler make-up and application. You may need to change your filler formula. — *Ralph G. Waring.*

Personal News

Mr. Arthur B. Wrigley has been appointed supervisor of trades and industries for the New Jersey State Department of Education. Mr. Wrigley, who was formerly principal of the Boy's Vocational School in Elizabeth, succeeds John A. McCarthy.

Mr. Raymond Johnson has been appointed as director of vocational rehabilitation in the schools of Tulsa, Okla. He will have charge of the work for physically handicapped boys and girls. He formerly taught at Turley, Clinton and Grover Cleveland high schools.

Mr. Grove Sollenberger has been named as director of the industrial arts at Schuylkill Haven, Pa.

Mr. Donald McCulley has been appointed instructor in mechanical drawing in the senior high school at Ashland, Ky.

Mr. James Jenkins has been appointed as vocational co-ordinator for the schools of Valparaiso, Ind. He will contact the local industries and will have charge of a new program of apprentice training, as well as trade extension work.

Mr. L. F. Graffis will be in charge of the newly introduced industrial-trades program in the state training school at Mandan, N. Dak.

New Publications

Simplified Mechanical Drawing

By Thurmon C. Crook, B.S. Cloth, 174 pages, 9¼ by 7, illustrated. Price, $1.28. Published by McGraw-Hill Book Co., Inc., New York City.

This is a revised edition of a textbook designed for beginners. The work has been divided into four units, the first of which covers a description of the drafting instruments used, how to make the sheet layout, determining the location of the views, the conventional lines used on drawings, and the making of projections. Unit 2 presents more projection problems, the making of drawings to scale, and isometric drawing. Unit 3 presents the making of working drawings of more complicated articles, and unit 4 consists of making detail drawings and assemblies of a quite complicated nature. The appendix consists of a number of useful tables.

Braiding and Knotting for Amateurs

By Constantine A. Belash. Cloth, 126 pages, 5⅛ by 7⅝, illustrated. Price, $1. Published by The Beacon Press, Boston, Mass.

This is an interesting book on the subjects mentioned in the title. The descriptions for making the various braids and knots are simple and easily understood and directions for using the various materials such as grasses, cord, cloth, leather, and the like are given.

The Leathercraftsman

By W. E. Snyder. Cloth, 176 pages, 6 by 9½, illustrated. Price, cloth, $2; paper, $1.50. Published by The Davis Press, Inc., Worcester, Mass.

A helpful text on leatherwork. It contains a brief history of leather, a good description of the various kinds now made with information as to their adaptability to craftwork. The tools needed by the leatherworker and the various processes are explained in a concise and thorough manner. The book contains descriptions of a number of very fine projects all beautifully illustrated.

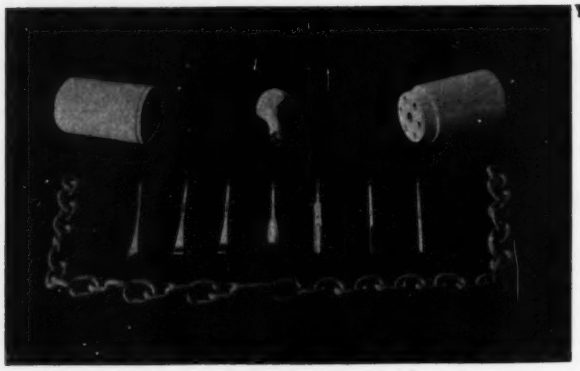
News Notes

Examination for Instructor in Indian Arts and Crafts

The United States Civil Service Commission has announced an open competitive examination for the position of instructor in Indian arts and crafts. The position carries a salary of $2,000 a year. The instructor will be expected to co-operate with the Indians in local areas for the production and improvement of their native arts, and to serve as an intermediary between the arts and crafts board and all local groups planning, producing, and selling Indian arts and crafts work. Applications must be on file with the U. S. Civil Service Commission, Washington, D. C., not later than September 20, 1937.

(Continued on page 25A)

THE MARKET PLACE



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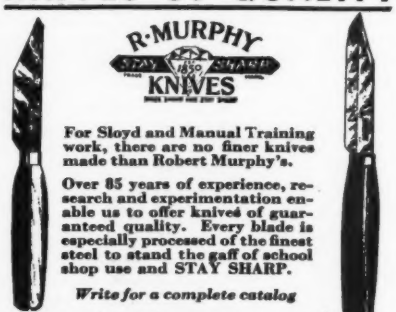

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(Continued from page 23A)

Examination for Instructors in Spanish and French

The United States Civil Service Commission has announced an examination for the position of instructor in Spanish and one in French, each to carry a salary of $3,200 a year. Applications must be on file with the U. S. Civil Service Commission, Washington, D. C., not later than September 20, 1937.

School to Offer Trades Study

The state training school at Mandan, N. Dak., has introduced an industrial-trades program for training in mechanical and electrical trades. The course will offer instruction in automobile mechanics, farm mechanics, bench repair, inside wiring, and related information. Mr. L. F. Graffis is in charge as instructor.

Home Economics Added

The board of education at Ocilla, Ga., has established departments of home economics and vocational agriculture in the Negro school.

New Vocational School

A vocational course for diversified industries has been introduced in the Wilson High School, in Portsmouth, Va. The course is designed to provide high-school students with practical training in business and industry while attending school at the same time.

National Conference on Educational Broadcasting

The second national conference on educational broadcasting will be held at the Drake Hotel, in Chicago, November 29 to December 1.

Demonstration of Handicrafts

A series of demonstrations in the field of handicrafts will be held throughout the fall in the New York Museum of Science and Industry in Rockefeller Center, New York City, beginning with September 30 and continuing for eight weeks ending November 13. Among the activities demonstrated will be pottery, woodworking, block printing, metal and jewelry work, etching, and numerous craft activities suited to the sick and convalescent.

School-Shop Equipment News

ANNOUNCE NEW OLIVER SPINNING LATHE

The Oliver Machinery Company, Grand Rapids, Mich., is marketing a new metal-spinning lathe, which embodies every advanced feature for this type of lathe.

Mr. Harry M. Dexter, Central High School, Grand Rapids, Mich., at the Oliver metal-spinning lathe

This lathe is equipped with the Oliver ball-bearing variable unit type motor-driven headstock and can be adjusted to any speed from 800 r.p.m. to 2,400 r.p.m. The 12-in. lathe has a ¾ h.p. motor, an enclosed dial-operated switch with overload protection, a headstock with a substantial thrust ball bearing, a spindle made of highest grade steel, a plunger-type positive lock, and a tailstock of open-side design with positive lever clamp

A hand-feeding carriage with a compound swivel rest, a special socket, and a set-over tailstock may be had as extra equipment.

Examples of work made on the Oliver spinning lathe

A set of five spinning tools is included with the lathe, as well as long floor legs, making the top of the bed 36 in. from the floor. A lathe with short legs can also be furnished.

Complete information is available upon request.

NEW COLUMBIAN FACTORY ADDITION

The Columbian Vise and Mfg. Company, Cleveland, Ohio, has announced the completion of a new addition to their main plant, which offers additional facilities for production and stock facilities. The addition will increase the floor space by 30 per cent and will insure prompt service for all the firm's customers.

The floor space in the new wing will be devoted to raw-material storage, will release considerable space for increased production.

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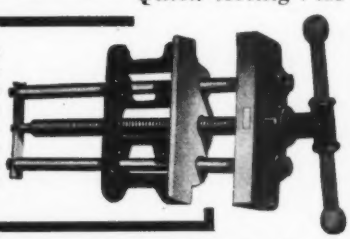

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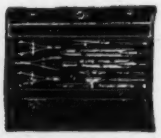

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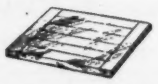

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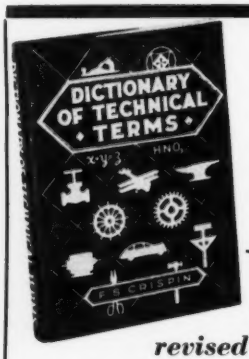

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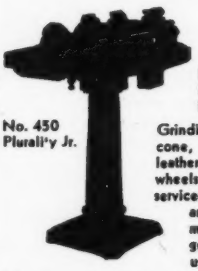

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